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Gahnia halmaturina (Cyperaceae: Schoeneae), a new species from Kangaroo Island, South Australia

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Abstract

As a precursor to the fifth edition of the *Flora of South Australia*, *Gahnia halmaturina* R.L.Barrett & K.L.Wilson is described as a new species from Kangaroo Island. This species was previously known by the phrase name *Gahnia sp. West Bay (B.M.Overton 2685) R.L.Taplin*. A revised key to South Australian species of *Gahnia* is provided.

Keywords: Cyperaceae, Schoeneae, *Gahnia*, South Australia, Kangaroo Island, taxonomy.

Introduction

Systematic studies in Cyperaceae, tribe Schoeneae, have shown that there are a number of undescribed taxa in many of the Australian genera. A potentially new species on Kangaroo Island was first collected in 1998 by Bev Overton and was unknown when the previous edition of the *Flora of South Australia* (Jessop & Weber 1986) was published. Rosemary Taplin gave it the informal name *Gahnia sp. West Bay (B.M.Overton 2685) R.L.Taplin* in the South Australian Herbarium (Barker et al. 2005). Study of herbarium material of this taxon and comparison with collections of all other named Australian species of *Gahnia* J.R.Forst. & G.Forst. have confirmed that it represents a novel species. Molecular data have confirmed the relationships of this taxon (Barrett et al., unpubl.). The description is based on herbarium material.

Gahnia halmaturina* R.L.Barrett & K.L.Wilson, *sp. nov.

Gahniae hystrici *J.M.Black similis, sed habitu altiore, inflorescentia non contracta, foliis longioribus flexuosisque non pungentibus, antheris quattuor, differt.* Gahniae microstachyae *(R.Br.) Benth. similis, sed foliis non applanatis, spiculis grandioribus pallidisque distinguitur. Ab ambobus speciebus foliis culmisque papillatis distinguitur.*

Typus: South Australia: Kangaroo Island: Flinders Chase National Park, West Bay Creek S Tributary, 2.3 km E of West Bay, N side of West Bay track, 35º53′20”S, 136º37′50”E, 12 Apr. 1999, *B.M. Overton 2744* (holo.: AD 99920049; iso.: NSW).

Gahnia sp. West Bay (B.M.Overton 2685) R.L.Taplin in W.R. Barker et al., J. Adelaide Bot. Gard. Suppl. 1: 189 (2005).

Tufted perennial with short, compact rhizomes. *Culms* and *leaves* spirodistichous; leaf to culm length ratio 0.6–0.9:1. *Leaves* flexuose, erect to spreading, margins tightly inrolled when dried, sometimes appearing terete with a groove on one side, finely striate, dull green (pale to cream at base), not glaucous, covered in very fine papillae, silica bodies prominent on upper surface, 23–70 cm long, 0.7–1.8 mm wide (when dried and margins inrolled), 0.2–0.5 mm thick (when flat); margins very finely scabrous due to papillae; sheath 3.5–10 cm long, pinkish brown to dark chocolate-brown, finely striate and covered in very fine papillae; *ligule* a pale band of tissue, glabrous, c. 0.5 mm high. *Culms* terete, often paler than leaves, otherwise as for leaves, 14–65 cm tall, 0.7–1.7 mm diam. *Inflorescence* ± linear in outline, 7–16 cm long, 7–20 mm wide, with several lateral branches, 1 lateral branch per node; basal lateral branch 18–95 mm long (note majority of peduncle is hidden by sheath of involucral bract) with 9–19 spikelets; primary involucral bract 20–31 cm long, leaf-like. *Spikelets* 3.6–4.4 mm long, the upper flower bisexual, the lower flower functionally male; *glumes* c. 10, pale to dark brown, darkest at the keel, glabrous, apex obtuse, mucronate; lowest 6 glumes sterile; fertile upper glumes 2.5–3.1 mm long, c. 1.1 mm wide (when incurved). *Stamens* 4; anthers 1.3–1.7 mm long, 0.3–0.5 mm wide, apical appendage 0.2–0.3 mm long; filaments

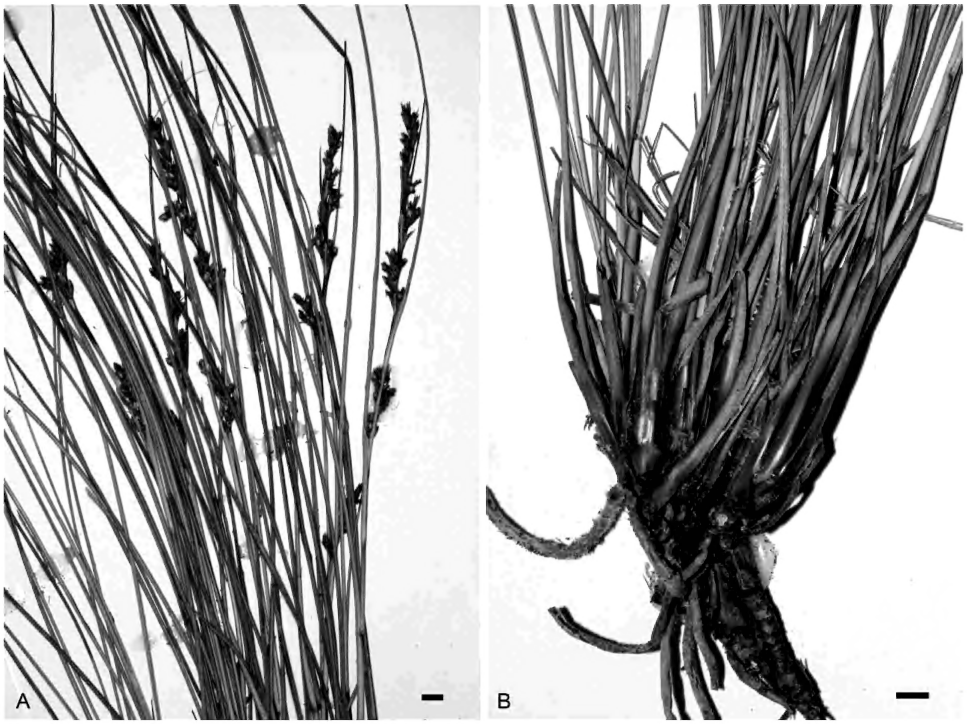

Fig. 1. ***Gahnia halmaturina***: **A** inflorescences; **B** culm bases. Scale bar: 1 cm. *B.M. Overton 2744.*

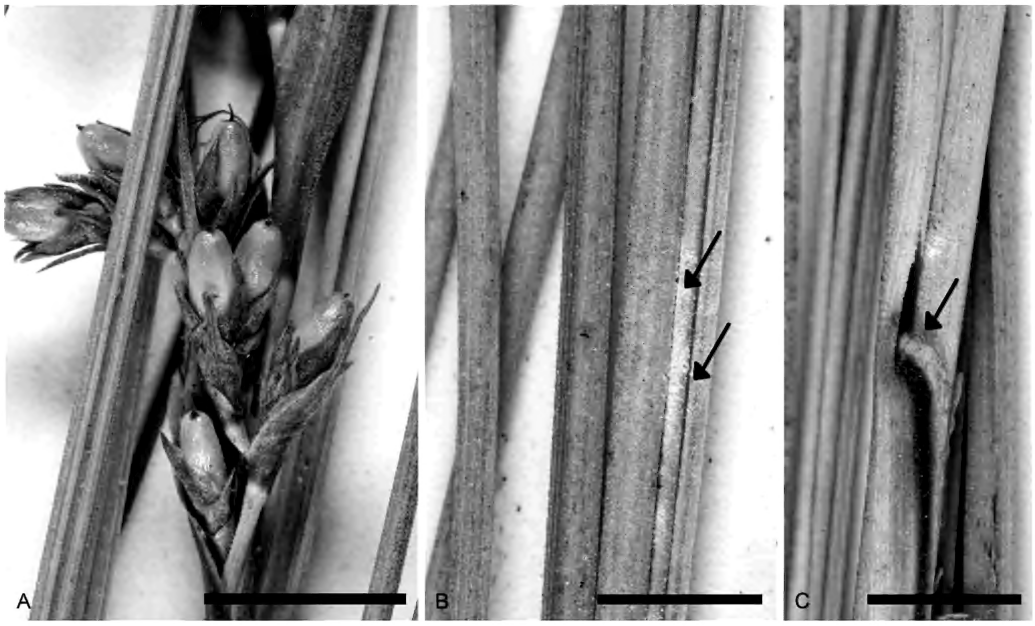

Fig. 2. ***Gahnia halmaturina***: **A** spikelets; **B** leaf margins (arrows); **C** leaf ligule (arrow). Scale bar: 5 mm. *B.M. Overton 2744.*

3.0–3.7 mm long at maturity. *Style* 3-fid (occasionally 1 of these further branched dichotomously, producing a 4-fid style), undivided portion c. 1.9 mm long, branches 1.6–2.2 mm long. *Nut* not held by the staminal filaments at maturity, cream to pale brown, smooth, narrowly ovate in outline, tapering towards the base, terete in cross-section to obscurely 3-angled, 3.0–3.3 mm long, 1.05–1.18 mm wide; epidermal cells narrowly oblong to subhexagonal or almost linear in outline. **Figs 1, 2, 3.**

Distribution and habitat. Endemic to Kangaroo Island, apparently restricted to the vicinity of West Bay in Flinders Chase National Park. This species is only known from the margins of freshwater creeks, growing on rocky areas along the banks and floodplains.

Phenology. Flowering recorded for April–May. Fruit collected in April, May and August.

Conservation status. Listed as 'Rare' (under its phrase name synonym) in Schedule 9 of National Parks and Wildlife 1972, 2008 Amendment (South Australia), as reflected in Barker et al. (2005). Based on collection notes, at least 1,200 individuals are known from several subpopulations over a distance of about 1.5 km. Given the limited distribution, the current listing is considered to be appropriate.

Etymology. Derived from *Halmaturus*, a generic name once applied to kangaroos (Smith 1870), ultimately derived from the Greek *halme*, a leap or bound, and commonly used as an epithet for species from Kangaroo Island.

Notes. Molecular data place this species as related to *Gahnia hystrix* J.M.Black, also endemic to Kangaroo Island, and *G. trifida* Labill. (Barrett 2012). *G. halmaturina* and *G. hystrix* are very easily distinguished by their growth habit and habitat, *G. hystrix* being a small cushion-forming plant growing on limestone, while *G. halmaturina* is a much taller, clumping plant growing on creek margins. The two are somewhat morphologically similar in having leaves exceeding the inflorescence and relatively few, large spikelets. *Gahnia trifida* is easily distinguished in the field from *G. halmaturina* by its much larger stature.

This species is superficially similar to *Gahnia microstachya* (R.Br.) Benth. from New South Wales, Victoria and Tasmania, differing from that species in the inflorescence being held below the level of the leaves, the leaves not clearly flattened and spread more evenly along the culms rather than all strongly clustered at the base, and the larger, paler spikelets. *G. microstachya* prefers dry rocky sites (Wilson 1993).

Both *Gahnia hystrix* and *G. microstachya* lack the distinctive papillae found on the leaf blades and sheaths and culms of *G. halmaturina*.

Other specimens examined.

South Australia. **Kangaroo Island:** Track to Cape Borda from West Bay, 1.7 km N of gate from West Bay track (200 m upstream), 3 May 2006, *D.J. Duval 471, A. Quarmby & R.T. Taplin* (AD; K n.v.); Flinders Chase National Park, 2.3 km E of West Bay camping ground, 2nd West Bay creeklet, 12 Feb. 1998, *B.M. Overton 2685* (AD, PERTH); 12 Aug. 1998, *B.M. Overton 2697* (AD, PERTH); West Bay, Flinders Chase National Park, at West Bay Creek fork, almost 2 km E

Key to *Gahnia* species in South Australia (adapted from Jessop & Weber 1986)

1. Inflorescence held within plant, shorter than the leaves, small, not paniculate; spikelets 4–19
  2. Spikelets 9–19 in a shortly branched inflorescence; plant to 70 cm tall . . . . . ***G. halmaturina***
  2: Spikelets c. 4 in a simple spike-like inflorescence; dwarf plant . . . . . ***G. hystrix***
1: Inflorescence distinctly longer than the leaves (occasionally less in *G. ancistrophylla* but then leaf tips are distinctively coiled), paniculate; spikelets numerous
  3. Mature nut adhering to the persistent staminal filaments; culms stout, usually 1–2 m high; glumes and bracts broadish, never long-acuminate; nut 2–4 mm long, shining
    4. Glumes 12–17, the lowest 7–10 much shorter, all more or less obtuse, the lowermost without awns . . . . . ***G. clarkei***
    4: Glumes 5–10, of similar length, mostly acute, the lowermost long-mucronate . . . . . ***G. sieberiana***
  3: Mature nut never held by the staminal filaments; culms slender, usually 15–100 cm high; at least the outer bracts long-acuminate; nut c. 2 mm long or less, often dull or greyish
    5. Spikelets 1-flowered, densely clustered
      6. Lower leaf-like bracts of inflorescence smooth or minutely scabrid, conspicuously reddish-purple below; nut c. 5 mm long, more or less linear to very narrow-ovate in outline, triquetrous in cross-section, pale yellow-brown to very dark brown . . . . . ***G. filum***
      6: Lower leaf-like bracts of inflorescence coarsely scabrid, green or slightly yellow-tinted below; nut 2–2.5 mm long, narrow-obovate to narrow-elliptical in outline, trigonous in cross-section, grey to black . . ***G. trifida***
    5: Spikelets 2-flowered, more or less loosely arranged
      7. Ligule a dark brown chartaceous band to 2 mm wide; panicle broadly oblong with branches somewhat spreading or even recurved . . . . . ***G. radula***
      7: Ligule ciliate to woolly with hairs 2–4 mm long; panicle linear or linear-lanceolate with branches stiffly erect
        8. Leaves very scabrous at least on the margins in the upper half . . . . . ***G. deusta***
        8: Leaves smooth
          9. Leaves with curved or coiled filiform tips; leaf sheaths dull . . . . . ***G. ancistrophylla***
          9: Leaves with straight tips; basal leaf sheaths shining at least in part . . . . . ***G. lanigera***

Fig. 3. Holotype of ***Gahnia halmaturina*** (AD), *B.M. Overton 2744*. Scale bar: 5 cm.

of west coast, 11 Apr. 1999, *B.M. Overton 2743, D. Walters, C. Graham & S. Graham* (AD); Flinders Chase National Park, West Bay Creek, upper portion of S tributary, 400 m E of gate to old Cape Borda track, 12 Apr. 1999, *B.M. Overton 2745, D. Walters, C. Graham & S. Graham* (AD, NSW); Flinders Chase National Park, West Bay Creek, N tributary, 1.7 km N of West Bay track on old Cape Borda track, 12 Apr. 1999, *B.M. Overton 2746, D. Walters, C. Graham & S. Graham* (AD); Southern tributary of West Bay creek, 2.3 km E of West Bay camp ground northern side of West Bay track, Flinders Chase National Park, 12 Apr. 1999, *B.M. Overton BM 2749, D. Walters, C. Graham, S. Graham* (AD, PERTH: 2 sheets).

Acknowledgements

We would like to thank Rosemary Taplin, Jürgen Kellermann, Bill and Robyn Barker, and Helen Vonow for assistance at AD, and National Parks South Australia staff for assisting with associated fieldwork in South Australia. Neville Walsh (MEL) is thanked for taking RLB to examine *G. microstachya* in the field in Victoria.

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Boletus edulis (Boletaceae), a new record for Australia

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Abstract

Fungi belonging to *Boletus* section *Boletus*, known in Italy as porcini, in France as ceps, are prized for their good flavour and command a high price. They are ectomycorrhizal, forming symbiotic associations with a wide range of host plants, and although endemic to the Northern Hemisphere have been introduced into South Africa and New Zealand. We report here that *Boletus edulis* Bull. has become established broadly across the higher parts of the Adelaide Hills in South Australia in mycorrhizal association with at least three species of exotic trees. ITS sequence and morphological data were utilised to confirm the identity of the fungus and a full description of the Adelaide Hills collections is provided.

Keywords: naturalised and introduced fungi, edible fungi, *Boletus*, porcini, ceps, *Quercus*, *Pinus*, *Castanea*, Australia.

Introduction

Boletus section *Boletus* comprising *Boletus edulis* and several allied species are of significant economic importance due to their excellent flavour both when fresh and dry and to their high nutritional value (Çaglarlrmak et al. 2002; Ribeiro et al. 2008; Sitta & Floriani 2008). Annual worldwide consumption of porcini has been estimated to be between 20,000 and 100,000 tons (Hall et al. 1998) with a world market value exceeding $250 million. Prices range from $20−$80/kg in the northern hemisphere autumn but have reached as high as $231/kg in a poor fruiting season in New York in 1997 (Hall et al. 2003).

Boletus sect. *Boletus* is characterised by the spongy hymenial surface of tubes and pores which is initially whitish due to the pores being covered with a white hyphal mass. The tubes and pores become yellow to olive-yellow and lose the hyphal web on maturity. The flesh does not discolour on cutting or bruising. The stipe is usually bulbous and has a raised reticulum, at least on the upper part. The pileus is hemispherical when young and brown to chestnut in colour (Watling 1970; Singer 1986; Breitenbach & Kranzlin 1991; Cortecuisse 1999; Beugelsdijk et al. 2008).

Species in *Boletus* sect. *Boletus* are ectomycorrhizal, growing in association with a wide range of tree species in the families Fagaceae, Betulaceae, Malvaceae, Cistaceae, Salicaceae and Pinaceae (Hall et al. 1998; Agueda et al. 2006; Beugelsdijk et al. 2008; Dentinger et al. 2010). *Boletus* sect. *Boletus* is endemic in the northern hemisphere and does not occur naturally in the southern hemisphere. However, *B. edulis* has been introduced into South Africa (Marais and Kotze 1977; Hawley 2008) and New Zealand (Wang et al. 1995; Hall et al. 1998; Stringer et al. 2001). *B. edulis* has not previously been reported from Australia (Watling & Li 1999; Roy Halling, pers. com., 2010) although an endemic true porcini with the provisional generic name "*Inferiboletus*", estimated to have diverged from *Boletus* 34 Mya, has recently been reported for Australia (Dentinger et al. 2010).

We first observed and collected material (*PSC 2651*) consistent with the macroscopic and microscopic characters of *Boletus* sect. *Boletus* in South Australia in May 2007 associated with *Quercus robur* L., although it is likely to have been present and known to European immigrants somewhat earlier. More material was found fruiting in May 2009, April 2010 and March 2011 (Fig. 1) at the same and a nearby site and another collection (*PSC 3004*) was made. Further reports in April and December 2010 of porcini-like boletes associated respectively with *Castanea sativa* Mill. and *Pinus radiata* D. Don, led to more collections (*PSC 3273* and *PSC 3458*). Following early autumn rain in 2011, a report appeared in the Adelaide press on 2 Apr. 2011 of porcini being collected in the Adelaide Hills and sold at up to $120/kg in the Adelaide Market (Wilkinson 2011). A short survey on 12 Apr. 2011 led to finding a further six locations in the Adelaide Hills where the fungus was associated with *Q. robur* or *P. radiata.* A full evaluation of the collections was made due to the importance of porcini as a high value commercial crop and their potential to form mycorrhizal associations with a wide range of tree species.

Fig 1. ***Boletus edulis***. Adelaide Hills, March 2011, under *Quercus robur*. See back cover of journal for colour reproduction of this photograph.

Methods

Morphology

Habitat and associated plant communities were noted in the field. Collection locations were recorded by GPS (Garmin GPS12) and in situ photographs taken using a Nikon 4500 camera. Macroscopic characters were described directly from fresh material. Colours are described in general terms and more precisely according to the Royal Botanic Gardens Edinburgh Colour Chart (1969) (given as colour descriptor and number e.g. rust 13) and Kornerup & Wanscher (1978) (page number, column letter, row number e.g. 2B4). Fresh material was dried in a food dehydrator at 35°C for 24 h (Hydraflo 1000FD).

Sections of fresh and dried material were mounted in 5% aqueous KOH, then stained with ammoniacal Congo Red. Measurements were made at ×400 or ×1000 with an ocular micrometer. Illustrations of microscopic characters were made using an Olympus drawing tube system. Measurements are the normal range observed with outliers, if any, in brackets. Spore dimensions are given as length range × width range (n = 30). The length: width ratio (Q) of individual spores is presented as the range and mean of Q values. Measurements do not include the apiculus. Basidia and cystidia dimensions are recorded as length range × width range (n = 20). All illustrations are based on collections *PSC 2651*, *PSC 3004*, *PSC 3273* and *PSC 3458*. All collections have been accessioned into the State Herbarium of South Australia (AD).

DNA Extraction, amplification and processing

DNA was extracted from 5–10 mg of dried specimens by freezing with liquid nitrogen and grinding in a pestle and mortar with 500 µl of pH 8.0 isolation buffer (50 mM Tris-HCl, 170 mM EDTA, 1% N-lauroylsarcosine). The frozen paste was allowed to thaw, transferred to a 1.5 ml Eppendorf tube and incubated at 65°C for 5 min. Following addition of 300 µl 7.5 M ammonium acetate, the tubes were mixed by inversion, incubated on ice for 10 min. and then centrifuged at 13,000 g for 5 min. The supernatant (700 µl) was transferred to a fresh tube, mixed with 500 µl of isopropanol and held on ice for 10 min. Following centrifugation at 13,000 g for 3 min., the supernatant was discarded and the tubes drained by inversion on paper towel. The pellet was dissolved in 250 µl Tris EDTA buffer (10 mM Tris 1mM EDTA

Fig 2. *Boletus edulis*, Adelaide Hills, *PSC 3273*, reticulum on stipe, under *Castanea sativa*.

Fig 3. *Boletus edulis*, Adelaide Hills, *PSC 2651*, showing extended reticulum on stipe, under *Quercus robur*.

pH 8.0), if necessary by incubation at 50°C for 5 min. and brief vortex mixing. PCR amplifications (20 µl) employed Phusion polymerase (New England Biolabs) in HF buffer, ITS1 and ITS4 primers (White et al. 1990) and 1 µl of a 1/20 to 1/100 dilution of the DNA extract. Amplification employed 5 min. at 98°C followed by 40 cycles (98°C 30 s, 57°C 15 s, 72°C 15 s) then 5 min. at 72°C prior to storage at 4°C. PCR products were purified using a PCK-1 kit (AdBiotec) and sequenced (AGRF) on both strands using the PCR primers. DNA sequence was assembled from unidirectional reads and sequences compared using Sequencher 4.9 (Gene Codes Corp., Ann Arbor, Michigan, USA) and blastn searches for similar sequences in GenBank conducted using NCBI software.

Results

Morphology

Specimens examined: *PSC 2651*, 19.v.2007; *PSC 3004*, 31.v.2009; *PSC* 3273, 15.iv.2010; *PSC 3458*, 27.xii.2010.

Description. Pileus (70–) 100–250 (–275) mm diameter, (22–) 40–50 mm high, more or less hemispherical when young, later becoming plano-convex, irregularly plane to slightly concave; brown, light brown, 6D4–7, 7D8, 7E6–8, 7E5–6 (Kornerup & Wanscher), fulvous 12, rust 13, rusty-tawny 14, brick 15 (Edinburgh Colour Chart); initially covered with white-grey bloom; dry becoming lubricous in centre; smooth to almost phlebioid in patches; margin rather irregular, projecting beyond tubes, wavy, finely revolute or involute, smooth, even, margin edge whitish with whitish bloom. *Flesh of cap* thick, solid, becoming rather spongy; white, cream, 4A2; not discolouring though turning slightly brown or reddish immediately under cap cuticle but not above stipe. *Tubes* emarginate to adnexed, with sulcus around stipe; separating easily from flesh; deep, 8–25 mm in centre; parallel; white, cream, becoming pale yellow 3A3–4, dull yellow, greenish-yellow 2B4, 2C4, 3B3–5, darkening to greyish-yellow 3C3 on cutting, not blueing. *Pores* initially white, cream, with whitish plug of tangled hyphae, later losing plug and becoming concolourous with tubes; not changing colour on bruising; small, 1–3/mm; rounded to angular, some irregular, slightly elongated; dissepiments thin to medium. *Stipe* (80–) 135–195 mm long, 30–68 (–98) mm diameter under cap, (32–) 70–98 mm in centre, 17–56 mm diameter 1 cm above base; ventricose or with bulbous base, occasionally cylindric; whitish, dull white-grey, pale brown, paler than cap, 5C4, 6C3–4, 7D4, creamy-brown under cap, creamy clay-pink, closest to 30, 5B4, paler, whitish-brown at base; surface covered with whitish reticulum (Fig. 2) to half way down stipe, rarely over most of stipe (Fig 3), reticulations raised, white, white-beige, slightly greyer than 2B; reticulations small at top, approx. 1 × 0.5 mm, larger below to 4.5 × 2 mm and more when most of the stipe is reticulated, lacunae shallow; surface rather waxy. *Flesh of stipe* thick, solid, white, not changing colour on bruising. *Spore print* olive brown, yellowish-brown, hazel 27, 5E5–7. *Spores* (Figs. 4A, 5A) fusiform-ellipsoid, cylindrical, more or less smooth, rather thick-walled, pale yellow-brown in KOH; with oil globules; (12–) 13.6–18.4 × (4.0–) 4.8–5.6 µm, mean 16.8 × 5.3 µm; Q: 2.4–3.8, mean Q: 3.17. *Basidia* (Figs. 4B, 4C, 5B) clavate, (24–) 34–53 × (7–) 8–10 µm, mean 35.8 × 9.6 µm; with (2–) 4 sterigmata; without clamp connections. *Cheilocystidia* (Figs. 4D, 5C) fusiform, lageniform, ventricose-digitate, 40–72 × 5.5–10 µm, hyaline in KOH. *Pleurocystidia* similar to cheilocystidia. *Pileipellis* a trichoderm of irregular and regular interwoven hyphae, hyphae 3–10 µm, many hyphae ascending, erect, exserted; slightly gelatinised; terminal elements 4–10 µm; septa without clamp connections. *Hymenial elements in reticulum of stipe* (Figs. 4E, 5D): *caulocystidia* abundant; fusiform, cylindric, subclavate, 42–75 (–85) × (6.5–) 8–13 µm, mean 62.2 × 8.9 µm (n=10); *basidia* clavate, 2–4 spored but mostly 3-spored, 36–44 × 11–14 µm. *Hymenophoral trama* of parallel hyphae.

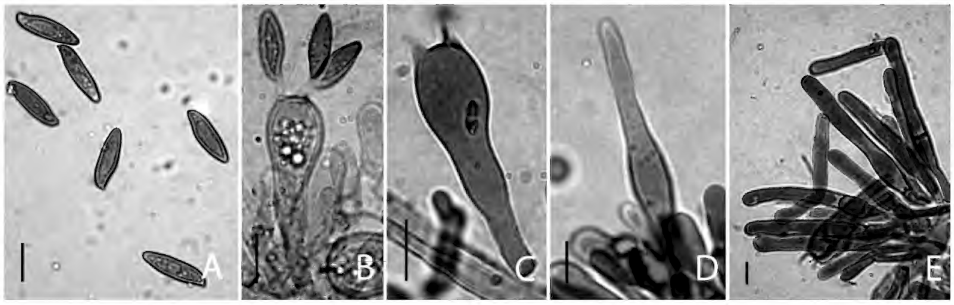

Fig 4. *Boletus edulis* micrographs of *PSC 2651*. **A** spores; **B, C** basidia; **D** cystidium; **E** caulocystidia. Scale bar: 10 µm.

Habitat. PSC 2651 in soil and deep leaf litter under *Quercus robur* L. with *Amanita muscaria* (L.) Lam., *Lepista nuda* (Bull.) Cooke and *Russula* sp., *Araucaria bidwillii* Hook. was nearby; *PSC 3004* in litter under *Quercus robur* L.; *PSC 3273* under 25 year old *Castanea sativa* Mill.; *PSC 3458* in soil and pine needle litter under *Pinus radiata* D.Don. with *Suillus granulatus* (L.) Roussel, *Rhizopogon rubescens* (Tul.) Tul., *Lactarius deliciosus* (L.) Gray. *Populus alba* L. and *Eucalyptus microcarpa* (Maiden) Maiden were also nearby.

Molecular data

PSC 2651, *3273* and *3458* each had the same ITS sequence (Genbank accession JQ277466). Blast searches of the NCBI database at 1 November 2011 identified 39 entries having a sequence identical to JQ277466: DQ990838 (Peintner et al. 2007), EU417846, EU417847, EU417849, EU417851, EU417852, EU417855, EU 417856, EU417857, EU417858, EU417859, EU417861, EU417862, EU417863, EU417864, EU417868, EU417869, EU417874 (Beugelsdijk et al. 2008), GU373493 (von Cräutlein et al. 2011), GU198977, GU198981, GU198982, GU198991 (Korhonen et al. 2009), JF728991, JF728992, JF728994, JF728995, JF728999, JF729002, AY680981 (De la Varga et al. 2011), AY680983, AY680984, AY680985, AY680991, AY680992, AY680993, AY680994 (Leonardi et al. 2005), DQ002921 and DQ131622 (Águeda et al. 2006).

Discussion

The porcini mushrooms, *Boletus* sect. *Boletus*, comprise a number of described species (Singer 1986; Wang et al. 1995; Beugelsdijk et al. 2008; Dentinger et al. 2010) whose relationships have been clarified considerably by molecular data (Leonardi et al. 2005; Beugelsdijk et al. 2008; Dentinger et al. 2010). *B. edulis* is now recognised as a taxon having variable morphology, a wide range of mycorrhizal partners and an extensive geographical range in the Northern Hemisphere. The molecular data suggest *B. edulis* includes the previously recognised species: *B. betulicola, B. chippewaensis*, *B. persoonii*, *B. quercicola* and *B. venturi*.

Morphologically, the Adelaide collections conform well to descriptions of *Boletus edulis* sensu stricto (Watling 1970; Singer 1986; Breitenbach & Kranzlin 1991; Cortecuisse 1999; Beugelsdijk et al. 2008) with respect to their microscopic and macroscopic characters. They differ from descriptions of the three other lineages recognised by Beugelsdijk et al. (2008) in *Boletus* sect. *Boletus*: *B. aereus*, *B. reticulatus* and *B. pinophilus.* None of the Adelaide collections have the dry, velvety darker brown cap and darker brown stem with a rust-brown reticulum of *B. aereus*; all had whitish or, at most, a pale brown stipe and the white to off-white reticulum usually reached no further than the stipe's centre, unlike the reticula of both *B. aereus* and *B. reticulatus* which cover the whole stem. Collection *PSC 3458* was found under *Pinus radiata* but no specimens had the thickly gelatinous cap pellicle or wide terminal elements of *B. pinophilus*; those in all our collections had terminal elements to 10 µm while those of *B. pinophilus* may reach 27 µm.

ITS sequences identical to those of the South Australian collections PSC 2651, PSC 3273 and PSC 3458 include AY680991, AY680992, AY680993, AY680994, AY680984, EU 417846, EU17847, EU17849, EU417851, EU417852, EU417855, EU417856, EU 417857, EU417858, EU417859, EU417861, EU417862, EU417863, EU417864 and EU417874 which are in the clade recognised by Beugelsdijk et al. (2008) as *B. edulis* and also DQ002921 which is within the clade recognised by Dentinger et al. (2010) as *B. edulis* sensu stricto. This sequence is dissimilar to the ITS sequence of any of the additional taxa within the *Boletus* sect. *Boletus* clade recognised by Dentinger et al. (2010). There is thus no doubt that *B. edulis* has arrived in Australia.

Matching ITS sequences to the Adelaide Hills *B. edulis* biotypes have been found in collections made in Austria, Belgium, Finland, Italy, Netherlands, Spain and Sweden, variously associated with *Betula*, *Castanea*, *Cistus*, *Fagus*, *Picea*, *Pinus* and *Quercus*. In consequence, the currently available molecular data provide insufficient information to identify the source of the introduction into South Australia.

All currently known populations of *B. edulis* in Australia are within 8 km of one another and within 7 km of Mount Lofty at altitudes ranging from 330 m to 470 m above sea level. The extent of this range and

association with three species of mature trees suggests that the introduction is not recent.

B. edulis is an obligate ectomycorrhizal fungus. Fruiting bodies have not been produced in culture, although efforts to cultivate the fungus in association with known plant hosts have had some success (Hall et al. 1998). These authors suggest that plantation forests of *Pinus* would be ideal habitats for *B. edulis*. In later work, Hall et al. (2005) observed *Amanita excelsa* ectomycorrhizas (ECMs) together with rhizomorphs of *B. edulis* penetrating the mantle around roots of their host plant and suggest that such co-symbionts may be mutually beneficial for all partners.

The discovery of *Boletus edulis* in South Australia raises the possibility of harvesting and managing this potentially valuable resource. A problem that might arise from deliberate cultivation of an introduced ectomycorrhizal fungus with a wide host range, such as *B. edulis*, is the possibility of its switching host to native trees. Although Malajczuk et al. (1982) found that ECMs of *B. edulis* did not form on any of the eleven species of eucalypt they tested for ECM formation, the possibility of *B. edulis* forming such symbioses with other Australian native species should not be discounted. Dunk et al. (2011) report on the invasion of *Amanita muscaria* into native *Nothofagus* forests in Tasmania and express the concern that such invasion may have detrimental effects on the ecosystem. Dunk et al. (2011) and Orlovich & Cairney (2004) comment on the lack of knowledge about the effect of the spread of exotic ECMs and emphasise the need for research into the long term consequences of the introduction or encouragement of potentially invasive mycorrhizal species.

Although recognition of the presence of the choice edible *Boletus edulis* in South Australia provides opportunities for exploitation of a new resource, there are corresponding risks which should be assessed before implementation of any actions to expand its distribution.

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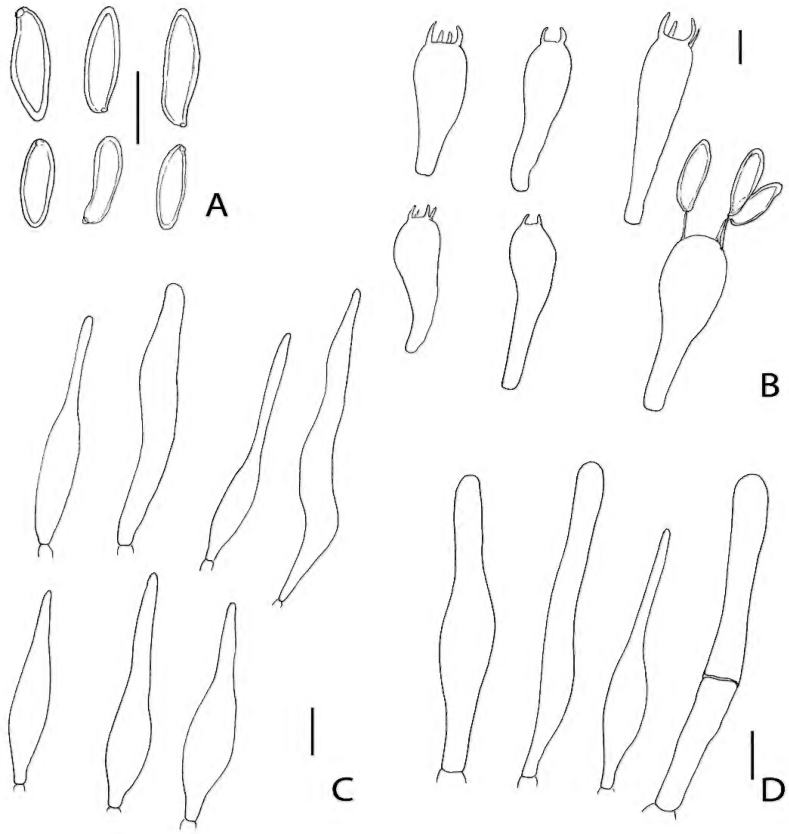

Fig 5. *Boletus edulis*, drawings of *PSC 2651*. **A** spores; **B** basidia; **C** cystidia; **D** caulocystidia. Scale bar: 10 µm.

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The genus *Alisma* L. (Alismataceae) in South Australia

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Abstract

The genus *Alisma* L. (Alismataceae) is revised for South Australia, with several populations previously incorrectly identified as the introduced weed *A. lanceolatum* With. (narrow leaved water plantain) found instead to be the native *A. plantago-aquatica* L. (common water plantain). The distinguishing features for these taxa and related Alismataceae in South Australia are given and the implications for their conservation and/or weed status are discussed.

Keywords: South Australia, *Alisma plantago-aquatica*, *Alisma lanceolatum*, Alismataceae, taxonomy.

Introduction

The monocot family Alismataceae consists of herbaceous aquatic macrophytes and is represented by 11–14 genera and ~100 species worldwide (Haynes et al. 1998, Jacobson & Hedrén 2007, Mabberley 2008), of which five genera and 11 species occur in Australia (Jacobs & McColl 2011). The genus *Alisma* L. (water plantains) has 9–11 species (Björkquist 1968, Wang et al. 2010), mostly widely distributed throughout the Northern Hemisphere of the Old World (Wang et al. 2010), but with three native species recognized for North America (Rubtzoff 1964, Haynes & Hellquist 2000). In particular, *A. plantago-aquatica* L. and *A. lanceolatum* With. are widespread throughout Eurasia with the former extending to Australia and the latter to North Africa, and both species are also introduced weeds in a number of places including North America (Haynes & Hellquist 2000) and New Zealand (Allan Herbarium 2000). *Alisma plantago-aquatica* has a natural range extending from Europe across to subtropical and temperate areas of SE Asia including China, Burma, Japan, Korea, Thailand and Vietnam and south-eastern Australia and its wide distribution (and presence in Australia) may be the result of long-distance transport of the fruits by migratory wetland birds (Green et al. 2002), but this requires further study.

In Australia, *A. plantago-aquatica* is considered to be native to at least New South Wales and Victoria (Aston 1973), as well as possibly introduced to south-east Queensland and Tasmania (Jacobs & McColl 2011), but its natural distribution requires further investigation. *Alisma* has been the subject of some taxonomic controversy in South Australia and it is unclear if it is native or an early introduction. However, based on the native distribution of *A. plantago-aquatica* in Victoria and its presence in the upper Murray and Wimmera River drainage systems, it should be expected to occur naturally in South Australia. *Alisma plantago-aquatica* was recorded in South Australia by Black (1922, as *A. plantago* non L.); however, there are early 20th century collections at AD made by him of both *Alisma plantago-aquatica* and *A. lanceolatum*. In contrast, Eichler (1965), Aston (1973), Jessop (1986) and Jacobs & McColl (2011) considered that the South Australian *Alisma* accessions all represented the introduced weed *A. lanceolatum*, also apparently failing to notice the presence of collections of both species.

As a result of field work by the author in wetlands across the Southern Lofty and South East regions, it quickly became apparent that there were two *Alisma* species in South Australia: the introduced *A. lanceolatum*, but also the native *A. plantago-aquatica*. Examination of all the *Alisma* collections at AD further supported this, as well as providing historical data on some now extinct localities for *A. plantago-aquatica*. Because the recent *Flora of Australia* account only lists one species in the State (Jacobs & McColl 2011), a revised account for South Australia is necessary both to update distributions, as well as to detail known localities of the native species for conservation. This is especially relevant as several native populations are the target of eradication programs due to misidentification as the introduced weed.

Taxonomy

Key to the species of Alismataceae in South Australia

1. Carpels weakly coherent into a star-like ring . . . . . ***Damasonium minus*** (R.Br.) Buchenau

1: Carpels distinct, forming heads or rings on a receptacle **2**

2. Flowers unisexual; carpels in a convex head . . . . . **Sagittaria platyphylla*** (Engelm.) J.G.Sm.

2: Flowers all bisexual; carpels arranged in a flattened ring **3**

3. Leaf blade narrowly elliptic to lanceolate, apex acute to acuminate, base cuneate, tapering; petals usually acuminate . . . . . 2. **Alisma lanceolatum*** With.

3: Leaf blade ovate to broadly lanceolate, apex bluntly acute to rounded, base ± rounded to cordate; petals usually broadly rounded **4**

4. Flowers pink; style longer than the ovary . . . . . 1. ***Alisma plantago-aquatica*** L.

4: Flowers white; style shorter than or equalling the ovary . . . . . ***Alisma triviale***[1] Pursh

Alisma L.

Sp. Pl. 1: 342 (1753).

Perennial, evergreen or geophytic, glabrous, rhizomatous herbs. Leaves emergent to submerged and floating, sessile or petiolate; lamina linear to ovate, margins entire, base attenuate to rounded or cordate, apex obtuse to tapering-acute. Inflorescence an erect, generally emergent, pyramidal compound panicle of 2–10 verticillate whorls; bracts acuminate. Flowers bisexual; pedicels spreading; pedicel bracts lanceolate, short, acuminate; sepals erect to spreading, sometimes recurving in fruit; petals pink or white, entire to apically subdentate; stamens 6, in pairs opposite the petals, filaments filiform, glabrous; carpels 12–20 around margin of flattened receptacle; ovule 1; style lateral to terminal. Fruits laterally compressed, abaxially 2–3-ribbed achenes. x = 7.

1. *Alisma plantago-aquatica* L.

Sp. Pl. 1: 342 (1753).

A. lanceolatum auct. non With.: Jessop in Jessop & Toelken, Fl. S. Austral. 4: 1709 (1986), partly.

'*A. plantago*' orth. var.: L., Syst. Nat. ed. 10, 2: 993 (1759), cf. Richt., Codex Bot. Linn. 351 (1835–1839); R.Br. in Flinders, Voy. Terra Austral. 2: 592 (1814); Woolls, Contrib. Fl. Austral. 150 (1867); Benth, Fl. Austral. 7: 185 (1878); F.Muell., Syst. Cens. Austral. Pl. 121 (1882) & Syst. Cens. Austral. Pl. ed. 2, 205 (1889); J.M.Black, Natural. Fl. S. Austral 143 (1909); Fl. S. Austral. 1: 49 (1922) & Fl. S. Austral. ed. 2, 1: 52 (1943).

Perennial aquatic herbs to 1.5 m, rhizome thick, corm-like, to 5 cm diam. Leaves emergent, petioles 5–40 cm long, 4–16 mm diam.; blade lanceolate to broadly elliptic or ovate, 2.5–30 × 1–12 cm, apex bluntly acute to rounded, base obtuse-tapering to cordate; venation acrodromous, mostly with 2 basal pairs and a single, strong suprabasal pair of secondary veins. Inflorescence to 150 × 50 cm. Flowers numerous in ~10 mm diam. clusters of 2–5, pedicels 3–45 mm; sepals ovate-lanceolate, green, 1.5–3.5 × 1.5–2 mm; petals broadly obovate, purplish-white to pink, 3.5–6.5 × 3.5–6 mm, margins entire to denticulate, apex obtuse to broadly rounded; anthers ellipsoid, 0.7–1.4 mm; style ± straight, 0.5–1.5 mm, ovary 0.4–0.6 mm long. Fruiting heads 4–7 mm diam.; achenes obovoid, 1.7–3.1 mm long, abaxial keels broadly rounded, with usually 1 median groove, beak ± erect. 2n = 14. **Common water plantain. (Fig. 1A–C).**

Distribution. S.A.: NL, SL, SE; Qld; N.S.W.; Vic; Tas; Europe and Asia. Naturalised in North and South America and New Zealand.

Habitat. Grows in damp ground or shallow water. Plants in permanently damp areas are evergreen, those in drier areas dying back to the thick, corm-like rhizome.

Conservation status. Rare in South Australia and apparently locally extinct at several localities. Threatened by habitat loss and eradication due to misidentification as *A. lanceolatum*.

Flowering and fruiting period. Dec.–Mar.

Affinities. Species taxonomy in *Alisma* has been problematic (Hendricks 1957, Voss 1958, Rubtzoff 1964), with the native North American former representatives of the very widespread and variable Old World taxon *A. plantago-aquatica* now regarded as separate species on stylar and other morphological characteristics (Björkqvist 1967, Haynes & Hellquist 2000), although the Eurasian species is also naturalised there (Haynes & Hellquist 2000). This separation is further supported cytologically, as *A. plantago-aquatica* is a diploid (2n = 14), whereas the North American segregate species *A. triviale* is a tetrapoid (2n = 28), as is *A. lanceolatum* (2n = 26, 28) (Baldwin & Speese 1955, Jacobson & Hedrén 2007).

Molecular analyses of evolution in the genus are still unclear, with evidence of relatively low genetic divergence between many taxa. The *A. plantago-aquatica* species complex was distinct and thought to be possibly more derived phylogenetically than *A. lanceolatum* (Jacobson & Hedrén 2007), but the origins of most of the polyploid taxa are uncertain. However, the phylogenetic study of *Alisma* by Jacobson & Hedrén (2007) did not include any native Australian material of *A. plantago-aquatica*, so its precise relationship to the European and Asian members of the complex are still unknown.

Note. The name of this species was published by Linnaeus as "*Alisma Plantago* △", which translates to "*Alisma plantago-aquatica*" (Art. 23.3, McNeill et al.

[1] Although not recorded as naturalised in Australia, *A. triviale* is cultivated at the Mount Lofty Botanic Gardens (accession no. G843495; listed in Sandham & Kellermann 2010 as *A. plantago-aquatica* var. *americanum* Schult. & Schult.f.), where it self-seeds freely in an artificially maintained bog and along an associated creek and dam (along with *Sagittaria platyphylla*). It is keyed here because of its very close resemblance to *A. plantago-aquatica* when not in flower and its possible weed potential.

2006). However, from the 10th edition of his *Systema Naturae* (1759), Linnaeus only used "*plantago*" as epithet of the species, a fact already noted by Richter (1835–1839). This orthographic variant of the name has been used by numerous authors throughout the years; the major publications relevant to Australia are listed in the synoymy.

Specimens examined.

South Australia. **Northern Lofty:** 1 km from Wirrabarra Forest Headquarters, 25 Apr. 1994, *R.J.Bates 37061* (AD 99522058). **Southern Lofty:** Reedbeds at Fulham (c. 8 km W of Adelaide), 18 Oct. 1908, *J.M.Black s.n.* (AD 97623463); Reservoir near Mount Lofty Railway Station, 13 Apr. 1960, *E.H.Ising s.n.* (AD 96220135, AD 96220136); Cresswell Park, Gilberton, 14 Jan. 1976, *A.G.Spooner 4525* (AD 97621406); Thomas Gully, Mt Bold Reservoir Track 43, 14 Nov. 2007 *D.J.Duval 946 & T.S.Te* (AD 214871, AD 214872); Woorabinda Res., Stirling Linear Park, 8 Oct 2011, *J.G.Conran 3142* (AD, ADU). **South East:** Millicent, town drain running toward Lake Bonney, 27 Nov. 1996, *D.Guerin s.n.* (AD 212157, AD 99650378).

2. ***Alisma lanceolatum* With.**

Arr. Brit. Pl. ed. 3, 2: 362 (1796).

A. plantago-aquatica auct. non L.: R.Br. in Flinders, Voy. Terra Austral. 2: 592 (1814); Woolls, Contrib. Fl. Austral. 150 (1867); Benth, Fl. Austral. 7: 185 (1878); F.Muell., Syst. Cens. Austral. Pl. 121 (1882) & Syst. Cens. Austral. Pl. ed. 2, 205 (1889); J.M.Black, Natural. Fl. S. Austral 143 (1909); J.M.Black, Fl. S. Austral. 1: 49 (1922) & Fl. S. Austral. ed. 2, 1: 52 (1943)., pro parte, as '*plantago*' (orth. var.).

Perennial aquatic herbs to 1.5 m, rhizome thick, corm-like, to 5 cm diam. Leaves emergent, petioles 5–50 cm long, 4–16 mm diam.; blade lanceolate, 3–25 × 1–6.5 cm, apex acute to acuminate, base cuneate, tapering; venation pinnate, mostly with 1 basal pair and two well-spaced suprabasal pairs of secondary veins. Inflorescence to 120 × 50 cm. Flowers numerous in clusters of 2–5, ~9 mm diam., pedicels 3–45 mm; sepals ovate-lanceolate, green, 1.5–3.5 mm; petals broadly oblanceolate to obovate, purplish-white to pink, 3.5–6.5 mm, margins entire to irregularly subdentate, apex acuminate to rounded acute; anthers ellipsoid, 0.6–1.1 mm; style ± curved, 0.5–1.5 mm, ovary 0.4–0.6 mm long. Fruiting heads 4–8 mm diam.; achenes obovoid, 2–3 mm long, abaxial keels broadly rounded, with 1–2 median grooves, beak ± erect. 2n = 28. **Narrow leaved water plantain. (Fig. 1D–F).**

Distribution. S.A.: SL; W.A.; Qld; N.S.W.; Vic; Tas.; native to Europe, North Africa and Asia.

Habitat. Grows in damp ground or shallow water. Plants in permanently damp areas are evergreen, those in drier areas dying back to the thick, corm-like rhizome.

Conservation status. A naturalised weed which appears to be spreading widely throughout the Onkaparinga River catchment

Flowering and fruiting period. Dec.–Mar.

Affinities. A phylogenetically somewhat isolated tetraploid species of uncertain origin (Jacobson & Hedrén 2007).

Specimens examined.

South Australia. **Southern Lofty:** Leslie Creek, Mylor, 7 Mar. 1986, *R.J.Bates 6784*, (AD 98631080); Mylor, banks of Onkaparinga River, 4 Feb. 1979, *L.D.Williams 10196* (AD 98426341); R[iver] Onkaparinga, n[ear] Longnook, 31 Dec. 1906, *S.A.White s.n.* (AD 97919317); Bridgewater, 20 Jan. 1919, *J.M.Black s.n.* (AD 97623464); Onkaparinga River, 31 Dec. 1906, *H.H.D.Griffith s.n.* (AD 97623462); Mylor, "Rockford" (property of Mr C.G. Little), at the Onkaparinga River, 14 Dec. 1967, *Hj.Eichler 19715* (AD 97616010); Clarendon Weir, 3 Dec. 1928, *J.B.Cleland s.n.* (AD 97236070); Onkaparinga River at Mylor, 2 Dec. 1938, *J.B.Cleland s.n.* (AD 97236071); Onkaparinga River, near Mylor, c. 20 km SE of Adelaide, 9 Dec. 1944, *J.B.Cleland s.n.* (AD 967510057, AD 95852022, AD 95852023); Onkaparinga River near the bridge of the road from Mylor to Echunga, 19 Mar. 1957, *Hj.Eichler 13699* (AD 95814005); Mylor, Aldgate Creek, near the bridge on the road to Aldgate, 19 Mar. 1957, *Hj.Eichler 13690* (AD 95813059, AD 95813049, AD 95813050, AD 95813051, AD 95813052, AD 95813043); Onkaparinga River at Verdun, 15 Feb. 1967, *B.Grivell s.n.* (AD 96932472, AD 96932463, AD 96932459, AD 96932456); Aldgate Valley reserve in creekline, 12 Mar. 2010, *C.J.Brodie 1528* (AD 235326).; SE corner of Happy Valley Reservoir c. 15 km S of Adelaide, 11 Jan. 1959 *R.Schodde 1069* (AD 96027072, AD 96027073, AD 96027074, AD 96027075, AD 96027076, AD 96027077); Creek crossing just S of Verdun on Onkaparinga Valley Rd c. 100 m N of turnoff to Mount Barker Rd, 2 Jan. 2012, *J.G.Conran 3240* (AD, ADU); Aldgate Valley Reserve, 7 Jan. 2012, *J.G.Conran 3241* (AD, ADU); Leslie Ck, Mylor Parklands, cnr Stock Rd and Strathalbyn Rd, 7 Jan. 2012, *J.G.Conran 3243* (AD, ADU); Cooper Reserve, Silver Lake Rd, Mylor, 7 Jan. 2012, *J.G.Conran 3244* (AD, ADU); Outfall creek/drain from Happy Valley Reservoir near cnr Chandlers Hill and Serpentine Rd, 18 Jan. 2012, *J.G.Conran 3245* (AD, ADU).

Discussion

All the Alismataceae listed here mainly occur in seasonally moist to permanently wet bogs and wetlands, where they grow in shallow water along creeks, lake or swamp margins, or in ditches. Although the *Alisma* species are all perennial, they can also behave as annuals and/or geophytes in climates with seasonal drought (Jacobs & McColl 2011).

Germination in *Alisma* often requires a combination of stratification and alternate drying/wetting cycles (Björkqvist 1967); *A. plantago-aquatica*, however, has different and more specific germination requirements than *Alisma lanceolatum* (Moravcová et al. 2001). Nevertheless, these studies were conducted for European populations where there are strong seasonal effects and the germination biology of the species in southern Australia has not been studied in detail.

Alisma lanceolatum, along with the noxious weed *Sagittaria platyphylla* and the native *Damasonium minus* are all considered to be weeds of rice fields in New South Wales (Mclntyre & Newnham 1988), with *S. platyphylla* also regarded as a weed in Western Australia (Sage et al. 2000). *Alisma* and *Damasonium* species

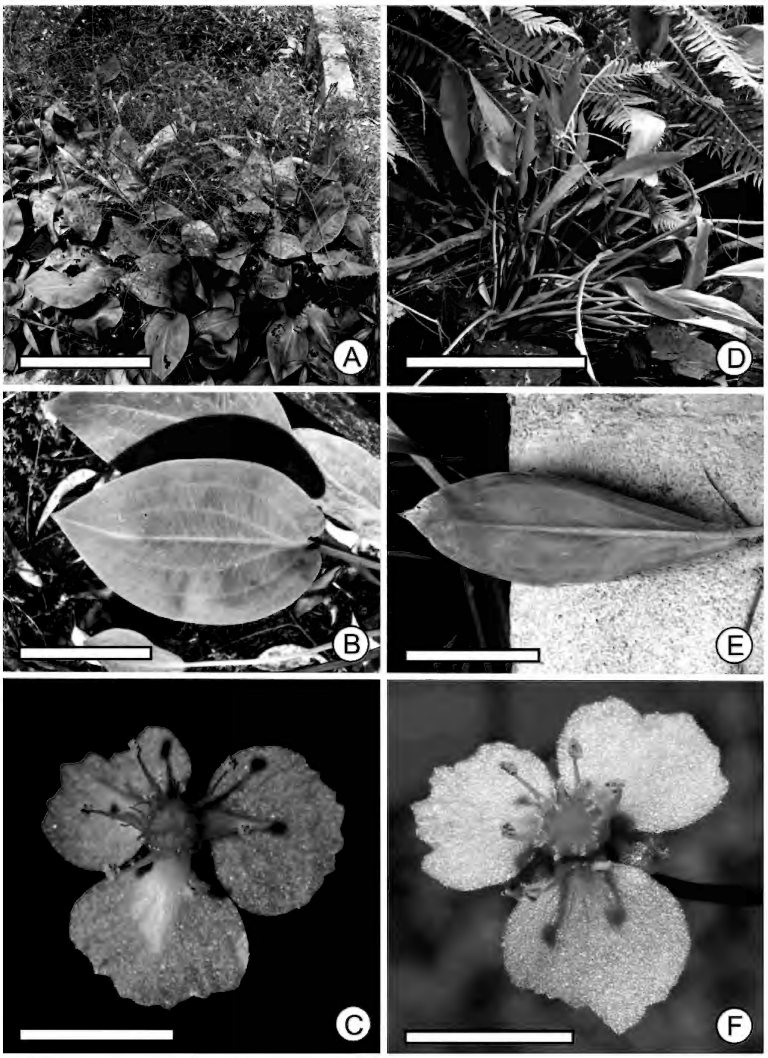

Fig. 1. *Alisma* species in South Australia. **A–C *A. plantago-aquatica*: A** habit; **B** leaf showing sub-cordate leaf with two pairs of basal and one suprabasal secondary leaf vein pair and percurrent tertiary venation; **C** flower showing rounded petals and more or less straight stigmas. **D–F *A. lanceolatum*: D** habit; **E** leaf showing lanceolate leaf with one pair of basal and two pinnate suprabasal secondary leaf vein pairs and percurrent tertiary venation; **F** flower showing ± acuminate petals and curved stigmas. Scale bars: **A**, **D** 20 cm; **B**, **E** 5 cm; **C**, **F** 5 mm.

have been found to show herbicide resistance and are the subject of studies for biocontrol (Ash et al. 2008), but this also has implications for the conservation of the native species in southern Australia.

The collections of *Alisma plantago-aquatica* in the State Herbarium of South Australia (AD) indicate that from the few collections made, it was probably never very common. Populations are no longer present in the Torrens River catchment and the vast majority of suitable habitat locations for the species in the Onkaparinga River catchment only appear to support *A. lanceolatum*. The single report for *A. plantago-aquatica* from the Northern Lofty in the Wirrabarra Forest needs investigation to see if the species is still extant there.

The South-East Region collections from Millicent were reported from the town drain running toward Lake Bonney, where it was noted on the specimen (AD 212157) that the population had grown rapidly and become locally dominant by 1996, despite an attempt to control with metsulfuron-methyl in 1994.

There are potential issues with the superficial similarity of sterile or juvenile *A. plantago-aquatica*

to the native *Plantago major* L. (Plantaginaceae) and the introduced *Zantedeschia aethiopica* (L.) Spreng. (Araceae), both of which grow in the same environments. Nevertheless, they are easily separated on leaf venation, as the tertiary veins in *A. plantago-aquatica* are strongly percurrent (ladder-like) between the secondaries (Fig. 1B), whereas they are reticulate in these others.

It is unfortunate that the failure in the past to realise that there were two *Alisma* species – one native and one weedy has meant that an already uncommon native plant in South Australia has possibly been targeted for removal due to its misidentification as a weed. Given that there are now very few localities for this species in the State, mainly due to habitat alteration/loss, it is probably just as well that it is resistant to the ALS inhibitor class herbicides that are commonly used to control aquatic weeds (Ash et al. 2008, Figueroa et al. 2008). Measures should be taken to encourage its conservation at those places where it still occurs, rather than physical or chemical removal.

More research, particularly cytological and genetic is needed to determine whether the specimens of *A. plantago-aquatica* are native to South Australia or an early introduction, as well as whether the species in Australia is the same as that in the Northern Hemisphere of the Old World. However, for the moment the species should be considered native until proven otherwise and conserved accordingly.

Acknowledgements

The School of Earth & Environmental Sciences, The University of Adelaide is thanked for provision of resources for this research. The Chief Botanist, State Herbarium of South Australia (AD), is thanked for access to specimens.

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Malva weinmanniana (Besser ex Rchb.) Conran, a new name for the pink-flowered form of *M. preissiana* Schltdl. (Malvaceae)

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Abstract

The two morphotypes of the Australian endemic *Malva preissiana* Miq. (Austral Hollyhock) are here regarded as separate, distinct species with the white-flowered *M. preissiana* a coprophilic halophyte on seabird-dominated near-shore islands, or rarely mainland shores or inland salt lakes used by seabirds. *Malva weinmanniana* (Besser ex Rchb.) Conran, based on *Lavatera weinmanniana* Besser ex Rchb., is the new name applied to the more common, pink-flowered, largely mainland taxon. The names *L. weinmanniana*, *L. plebeia* var. *eremaea* J.M.Black., *L. plebeia* var. *tomentosa* Hook.f., and *M. behriana* Schltdl. are lectotypified and their statuses discussed. A key to the taxa and a table of comparisons is supplied.

Keywords: *Malva*, *Lavatera*, Malvaceae, hybrid, nomenclature, taxonomy, southern Australia, South Australia, Western Australia, Victoria.

Introduction

The two ecotypes of the Australian endemic *Malva preissiana* Miq. (Austral Hollyhock) discussed in Barker & Conran (2007) are here regarded as separate, distinct species, based on morphological and ecological differences (Moore 1994, Lewis 1999). The white-flowered *M. preissiana* is primarily found on near-shore islands of the southern coast of Australia (Rippey *et al.* 2002, Zed *et al.* 2006), or more rarely from mainland shores or inland salt lakes associated with seabirds. *Malva preissiana* has for some time been recognised as being threatened by competition from, and hybridisation with, the introduced *M. arborea* (L.) Webb & Berthel. across its range and is in need of conservation (Rippey *et al.* 2002, Rippey 2004). The pink-flowered taxon, *M. weinmanniana* (Besser ex Rchb.) Conran, does not appear to be threatened but there is the necessity to be able to distinguish between all of the taxa concerned for conservation and monitoring purposes.

The differences between these taxa are summarised in Table 1 and a comparison of the flowers is shown in Fig. 1.

Key to taxa in the *Malva preissiana* complex and their hybrid with *M. arborea*

1. Leaves well-spaced along stems, upper surface much less tomentose than lower . . . . . ***Malva weinmanniana***
1: Leaves crowded together on stems and densely tomentose on both surfaces
  2. Flowers deep cerise pink with a dark purple to black centre . . . . . ***Malva arborea***
  2: Flowers white to pale pink with a pale centre
    3. Epicalyx lobes shorter than the calyx lobes . . . . . ***Malva preissiana***
    3: Epicalyx lobes and calyx lobes of similar length . . . . . ***Malva arborea* × *M. preissiana***

The *Malva preissiana* complex

Images of most type specimens cited are availabe on the following web-sites:

- herbarium.univie.ac.at/database/search.php (HAL)
- apps.kew.org/herbcat/navigator.do (K)
- www.lu.se/biological-museums/botanical-museum/databases (LD)
- www.plants.jstor.org (LD, K, TCD).

Specimens accessible through these databases are indicated with an asterisk.

Fig. 1. Flowers of the two native Malva species, *M. arborea* and the natural hybrid. **A *M. preissiana*** (*Conran 857*, ADU); **B *M. weinmanniana*** (*Conran 2038*, ADU); **C *M. arborea* × *M. preissiana*** (*Rippey 169*, PERTH); **D *M. arborea*** (*Conran 1527*, ADU). Scale bars 10 mm. See front cover of journal for colour reproductions of these photographs.

1. *Malva preissiana* Miq.

Miq. in Lehm., Pl. Preiss. 1(2): 238 (1845). — **Type citation:** "L. Preiss 1893, 14 Nov. 1839, Crescit in insula Penguin-Island" [S of Cape Peron, Rockingham, WA, fide Marchant (1990)]. **Syntypes:** LD 1065806!*; TCD 0010674!*, labelled "No. 654"; MEL 1528422! (ex Herb. Steetz); MEL 2282397!

Lavatera plebeia Sims var. *tomentosa* Hook.f., J. Bot. (Hooker): 412 (1840). — **Type citation:** "Near Woolnorth. Mr Gunn (n. 655), (also in New Holland, Cunningham)." **Lectotype (here designated):** *R. Gunn 655/18 [3]7*, 24 Nov. 1836, Van Diemens Land, near Woolnorth (K000659311!*, p.p., ex Herb. Hook.; Fig. 2). **Possible syntype or isosyntype:** *A. Cunningham 87*, [Jan 7] 1818, King George Sound (K000659315!*), p.p.

L. australis Schrad. ex Colla, Hortus Ripul. 1: 134 (1824), nom. nud.

[*Lavatera plebeia* auct. non Sims: Benth., Fl. Austral. 1: 185 (1863), p.p; F.Muell., Pl. Indigenous Colony Victoria 1; 166 (1860), p.p.; J.M.Black, Fl. S. Austral. 3: 373 (1926), p.p; J.M.Black, Fl. S. Austral. ed. 2, 3: 554 (1952), p.p.; W.R.Barker in Jessop & Toelken, Fl. S. Austral. 2: 833 (1986), p.p.]

[*Lavatera australis* auct. non Schrad. ex Colla: J.M. Black *Fl. S. Austral.* 3: 373 (1926).]

[*Lavatera plebeia* Sims var. *eremaea* auct. non J.M.Black: J.M.Black, Fl. S. Austral. 3: 373 (1926), p.p. (only as to *T.G.B. Osborn s.n.*, Jan 1922, Franklin Islands, AD 96303018!).]

[*Malva behriana* auct. non Schltdl.: W.R.Barker et al., Census S. Austral. Vasc. Pl. ed. 5 (= J. Adelaide Bot. Gard. Suppl. 1), 93 (2005), p.p.]

[?*Lavatera hispida* auct. non. Desf.: Benth., Fl. Austral. 1: 186 (1863) (see below)]

Table 1. Comparison of *Malva preissiana*, *M. weinmanniana*, *M. arborea* and the hybrid *Malva arborea* × *M. preissiana*.

Character	*Malva preissiana*	*Malva weinmanniana*	*Malva arborea* × *Malva preissiana*	*Malva arborea*
Habit	Usually sympodial and multi-stemmed at the base	± Monopodial, branches mostly arising along a main central stem	± Monopodial	± Monopodial
Stems	Densely tomentose	Densely tomentose	Densely tomentose	Sparsely hairy to sub-glabrous
Leaf arrangement	Clustered apically, internodes short	Widely spaced along stems, internodes long	Clustered apically, internodes short	Clustered apically, internodes short
Leaf indumentum	More or less equally densely tomentose on both surfaces	Less tomentose above; moderately to densely tomentose below	Tomentose on both surfaces	Tomentose on both surfaces
Leaf upper surface colour	Dark grey-green	Greyish yellow-green	Dark grey-green	Dark green
Pedicels	Usually shorter than the petals	Usually longer than the petals	Equalling calyx	Exceeding calyx
Epicalyx (bracteoles)	Not exceeding calyx	Not exceeding calyx	Equalling calyx	Exceeding calyx
Calyx in fruit	Enclosing mericarps	Enclosing	Enclosing	Not enclosing
Petal shape	Obovate	Obovate	Broadly reniform	Truncate-obovate
Petal apex	Deeply notched	Deeply notched	Shallowly notched	Truncate
Petal colour	White; unmarked to faintly mauve-striped	Pale pink; pink-striped	Pink; deeper pink-striped	Cerise; maroon-striped
Petal base and claw colour	Pale greenish	Pale yellowish	Pink	Deep blackish-maroon
Mericarps	11–12	11–12	10–11	6–7
Habitat	Coastal and offshore islands	Generally inland	Coastal and offshore islands	Coastal and offshore islands
Soil/nutrient preference	Coprophilic	Disturbed soil, not coprophilic	Coprophilic	Coprophilic, nutrient-rich, or disturbed soils

Typification of *Malva preissiana* Miq.

Preiss's collection of *Malva preissiana* in the Lund herbarium is available for viewing on the web as is another duplicate in the herbarium of Trinity College Dublin. However the authors have yet to see the Preiss collection from Miquel's own herbarium in Utrecht and so lectotypification of the name has not been undertaken. Other species named by Miquel in *Plantae Preissiana* have almost invariably been lectotypified by a specimen from Utrecht; e.g. see citations for a number of *Casuarina* L. and *Leptomeria* R.Br. species in the Australian Plant Name Index (APNI 2011–2012).

Placement of Bentham's *Lavatera hispida* Desf.

Bentham (1863) included *Lavatera hispida* Desf. (now generally considered to be *L. olbia* L. within *Lavatera* s.str., see Molero Briones & Montserrat Martí 2007) in his account of Malvaceae in *Flora Australiensis*, describing it as:

> a hirsute species with nearly sessile flowers forming a long terminal raceme or interrupted spike, and with broad hirsute involucres, a native of the Mediterranean region, appears to be naturalized in some islands of Bass's Straits (*F. Mueller*).

From Bentham's description, the specimens might belong to *M. preissiana*, or possibly represent naturalised material of *Malva arborea* (L.) Webb & Berthel, both of which are characteristically tomentose. However, at this stage no Mueller specimens from the Bass Strait Islands have been located in MEL and a search of Bentham's herbarium at Kew is required. Until specimens are located, the identity of this material and the application of the name remain unknown.

Typification of *Lavatera plebeia* var. *tomentosa* Hook.f.

In describing var. *tomentosa*, Hooker (1840) states:

> This seems to be the species alluded to under *L. plebeja,* in the *Bot. Mag.* as having been collected on the south coast of New Holland. The *var.* β [= *tomentosa*] differs from the described state of *L. plebeja,* in having the upper side of the leaf equally tomentose as the underside.

A sheet in Hooker's herbarium in K (K000659311 ex Herb. Hook.), reproduced here in Fig. 2, has a typical Gunn label with the number 655/18[3]7. It has been annotated as "L. plebeia Sims β" and also bears the collecting locality Woolnorth for the 24th November 1836. The label is clearly in agreement with the protologue. An additional locality on the label, Trefoil

Fig. 2. Lectotype (bottom left and top right branches) of ***Lavatera plebeia*** var. ***tomentosa*** (K 000659311). Available at apps.kew.org/herbcat/getImage.do?imageBarcode=K000659310 and used with the permission of the Trustees of the Royal Botanic Gardens, Kew.

Island, may or may not relate to the same date but it does suggest that there are two collections present. At the time of collection Gunn was the Police Magistrate at Circular Head in NW Tasmania and he made numerous trips to Woolnorth by the Van Diemen's Land schooner (Buchanan 1990); presumably one of these trips may have been extended further north to Trefoil Island off the NW coast of Tasmania.

Three of the specimens on the sheet have been identified with this label by a pencil line – the two on the bottom left and the one on the right hand side. At an earlier stage the label was presumably attached to one or all of these specimens. All of the specimens comply with Hooker's statement about the hairiness of the leaf, and there is a note by G. Krebs (Herbarium, University of Leipzig), dated 28th May 1985, that they represent type material.

The Cunningham specimen mounted on the same sheet as the lectotype (K 000659310!*, Fig. 2) is from Peel's Range (now Cocoparra Range), New South Wales and is labelled as *Lavatera australis*. It is *M. weinmanniana* (see below). Even though it is a Cunningham collection in Hooker's own herbarium, it bears a different name and is not in agreement with the protologue with respect to the hair covering on the leaves and so is presumed not to be the Cunningham specimen alluded to by Hooker in the protologue.

A sheet from Bentham's herbarium also has a Cunningham specimen (*A. Cunningham 87*; K 000659313*), collected in 1818 and mounted with a Horticultural Society of London specimen dated 6.9.[18]29 (K 000659315*). The Horticultural Society specimen is *M. weinmanniana*, while the Cunningham collection is *M. preissiana*. The latter possibly represents the Cunningham material alluded to in the protologue and therefore may be syntype or isosyntype material of Hooker's var. *tomentosa*.

Note

A specimen (*Andrews 254*; K 000659318*) in Bentham's herbarium, collected in the vicinity of Lake Eyre in Nov. 1875, also appears to be *M. preissiana*. Although far outside the normal coastal and offshore island range of this taxon, Lake Eyre is a major seabird rookery at times of inundation and the saline, guano-enriched rookery soils there could easily provide a suitable habitat for seeds carried by coastal seabirds migrating to these new, ephemeral breeding grounds.

2. *Malva weinmanniana* (Besser ex Rchb.) Conran, *comb. nov.*

Lavatera weinmanniana Besser ex Rchb., Iconogr. Bot. Exot. 1: t. 60 (1824), plate with analysis (Art. 42.3); p. 45 (1825), description; pp. xiv, 68 (1827), notes & addendum. — **Type citation (from the 1825 description):** "in Nova Hollandia, teste cl. Besser l.c. floret in hortis sub dio ad a Julio ad auctumnum". **Lectotype (here designated):** Reichenbach's plate t. 60! (Fig. 3).

Lavatera plebeia Sims, Bot. Mag. 48: pl. 2269 (1821), nom. illeg., non *M. plebeja* Stev., Bull. Soc. Imp. Naturalistes Moscou xxix. (1856) I. 325. Benth., Fl. Austral. 1: 185 (1863), p.p.; F.Muell., Pl. Indigenous Colony Victoria 1: 166 (1860), p.p.; J.M.Black, Fl. S. Austral. 3: 373 (1926), p.p.; J.M.Black, Fl. S. Austral. ed. 2, 3: 554 (1952), p.p.; W.R.Barker, Fl. S. Austral. 2: 833 (1986), p.p. — *Althaea plebeia* (Sims) Schult. ex Steud., Nomencl. Bot. ed. 2, 1: 210 (1840). — *M. australiana* M.F.Ray, Novon 8: 291 (1998). — **Type:** Sim's plate 2269! (see discussion in Ray 1998, p. 292. The implication is that this might be considered to be the holotype, but this designation is not used).

Lavatera australis A.Cunn. ex Hook.f., J. Bot. (Hooker) 2: 412 (1840), nom. nud. (based on a Cunningham collection from Peel's Range, now Cocoparra Range, New South Wales, and labelled as *Lavatera australis*; see K 000659310* and lectotypification of *L. plebeia* var. *tomentosa*, above).

Malva behriana Schltdl., Linnaea 20: 633 (1847). — *Lavatera behriana* (Schltdl.) Schltdl., Linnaea 24: 699 (1852). — **Type citation**: "In Thale des Murray-Flusses. Juli." [Behr]. **Lectotype (here designated):** *H.H. Behr s.n.*, July [1845], In Thale des Murray-Flusses (HAL 0098406!*). **Possible syntype or isosyntype**: *F. Mueller s.n.*, Australia (K 000659320*).

Lavatera plebeia Sims var. *eremaea* J.M.Black, Fl. S. Austral. 3: 373 (1926), p.p. — **Type citation:** "Ardrossan, Y.P.; Caroona, E.P. Ooldea; Franklin Islands; along the Great Bight". **Lectotype (here designated):** *T. Richards s.n.*, Nov. 1879, Euria (AD 96303017! p.p.). **Syntypes:** *O. Tepper s.n.*, 1879, Ardrossan (AD 96303017! p.p.; MEL 1528294 n.v.); *R. Tate s.n.*, 8 Feb. 1879, Gully Bunda Cliffs E from Wilson Bluff (AD 96303017! p.p.) — all from J.M. Black's herbarium at AD and annotated as var. *eremaea*. **Possible syntype:** *Anon. s.n.*, in Herb. J.M. Black, 24 Sep. 1920, Ooldea (AD 97612120B!), not annotated as var. *eremaea* by Black. [**Excluded syntype:** *T.G.B. Osborn s.n.*, Jan 1922, Franklin Islands (AD 96303018!) — see *M. preissiana*.]

The identity and validity of *Lavatera weinmanniana* Besser ex Rchb.

As with previous workers we had thought that this name was illegitimate until the proof stage of this paper, when it was discovered that the protologue of *L. weinmanniana* was merely the illustration (Reichenbach 1824) and not the associated description (printed a year later, in 1825), which included earlier names in synonymy. While the description no longer forms part of the protologue it is needed to check against earlier publications using this same name and also to provide an identification of the taxon concerned and ensure that it is associated with the correct Australian species.

In describing *Lavatera weinmanniana*, Reichenbach attributed the name to von Besser and referred to von Besser's (1823a) *Cat. Hort. Cremen.*, presumably a list of plants growing in the gardens administered by von Besser at Kremenets in western Ukraine. We have not been able to find a copy of this publication, but since it seems to be a list of names and since other names listed in this same publication, such as *Melilotus pallidus* Besser and *Rumex reticulatus* Besser, have been legitimised in later publications, we have treated von Besser's name as a nomen nudum. It may be that the publication referred to was von Besser's (1823b) seed list of the same year

for the same gardens and here the name was certainly a nomen nudum.

Reichenbach's name might still have been a later homonym because earlier in the same year de Candolle published *Lavatera weinmanniana* Trev. ex DC. However further investigation revealed that de Candolle (1824) had merely listed *L. weinmanniana* as a queried synonym of *L. sylvestris* Brot. (= *Malva linnaei* M.F.Ray); the author "Trev." who provided the original name is assumed to be L.C. Treviranus, Professor of Botany at the University of Bonn; no publication by him using this name has been traced.

Based on the protologue illustration and the later published description, especially the reference to pink flowers and widely-spaced sub-glabrous leaves, the species is clearly associated with the pink-flowered mainland taxon, and the name has been adopted here.

Publication and typification of *L. weinmanniana* Besser ex Rchb.

The publication of *L. weinmanniana* by Reichenbach was a protracted affair and our interpretation and acceptance of this name is reliant on the publication dates given in *TL-2* (Stafleu & Cowan 1983) being correct.

Reichenbach's illustration of *Lavatera weinmanniana* (Fig. 3) was published as plate 60 in 1824, the year before the publication of the detailed description of the species on p. 45. It has always been assumed that the publications were at the same time and so the citation of earlier names in the synonymy accompanying the description and notes on *L. weinmanniana* led to it being deemed an illegitimate name. However if it is just the illustration that forms the protologue, and this meets all of the criteria for valid publication, then the name has to be considered valid. Since the illustration includes a flowering branch with leaves as well as dissections of the various parts of the plant, viz. external and internal views of the calyx, the young fruit, the columella with a single carpel attached and a dorsal view of the carpel, it meets the requirements of the botanical code (Art. 42.3 & 42.4; McNeill et al. 2006), for an illustration with analysis, even though the caption was published with the later description, and the description is needed in order to determine some of the finer detail.

Subsequent mentions of *L. weinmanniana* in the same work include p. xiv of a section titled 'Erstes hundert' (The first one hundred, viz. of plates), which is in German and includes some horticultural notes as well as the comment that the plant is also called *L. australis* and *L. plebeja*, and that the name *L. sylvestris* was applied erroneously; this was published in 1827. In the same year a further section entitled 'Addenda et emendanda ad Centuram primam' included the statement on p. 68 that *L. weinmanniana* was the same as *L. plebeia*, but not *L. silvestris*:

> *L. weinmanniana* convenit omnino *L. plebeia* Sims Bot. Mag. 2269, cui pariter adscribiter patria Nova Hollandiae, est minime *L. silvestris*

Since the illustration is the basis for the name, it has here been designated as the lectotype. According to Stafleu & Cowan (1976–1988), the plates were hand-coloured copper engravings, this particular one by Reichenbach himself, although others were by Humm. There is no colour associated with the copy of the illustration reproduced here from the volume held by the library of the National Herbarium of Victoria (Fig. 3) and nor is there any colour associated with the copy of this publication available on the web.

Whether there are any extant specimens in what remains of Reichenbach's herbarium in W has not been established, but the name was clearly used in horticultural circles for some time before its publication and so there may well be some specimens with this name in European herbaria.

Etymology

Johannes Anton Weinmann (1782-1858), whose name presumably provides the epithet for this species, was a German born Russian botanist and gardener who worked in Dorpat (Tartu) in Estonia from 1804–1813 and then for Empress Maria Feodorowna (1759–1828), "Mother of Czars" (Grant 1905), at her palace in Pavlovsk, St Petersburg, Russia. The association of his name with the species in horticultural circles predated the protologue as indicated above, but there is no indication of why his name was used and what connection he had with Australian plants. This was however the peak of interest in Europe in plants from Australia and there was considerable exchange between the various gardens.

W.S.J.G von Besser (1784–1842), who is credited with naming the species after Weinmann, was an Austrian-Polish botanist at Kremenets, western Ukraine (then Russia), while Ludwig Reichenbach (1793–1879) was a German botanist and artist, and director of the Dresden botanical garden (Stafleu & Cowan 1976–1988).

Lectotypification of *Malva behriana* Schltdl.

Although there are no original labels by Behr on the specimen in HAL it bears the same information as is given in the protologue and is clearly the specimen used by Schlechtendal, then editor of *Linnaea* and resident in Halle, in describing *M. behriana*. It is therefore the obvious choice for lectotype of this name. A specimen at K in Herb. Bentham (K 000659320*) received from Mueller and previously in Sonder's herbarium has also been annotated with this name and may represent syntype or isosyntype material, although it was annotated on the 16th May 1985 by G. Krebs: "In my opinion not once [sic] of the 3 examplars is a Holo-, Iso- or Syn typus." While the leaves appear similar to those of the lectotype and flowers are present on both collections, the material in K does seem to be at a somewhat later stage since, unlike the lectotype, there appear to be young fruits present.

Fig. 3. Reichenbach's (1824) illustration and lectotype of ***Lavatera weinmanniana***. Reproduced with permission from the State Botanical Collection, Royal Botanic Gardens Melbourne.

Placement of *Lavatera plebeia* Sims

Ray (1998) designated Sim's (1821) plate as the type, and the depiction of widely spaced leaves and pink flowers with a yellowish centre supports its placement here. Furthermore, the accompanying description implies that the upper leaf surface is less hairy than the lower and also indicates that the original specimen was from an inland expedition beyond the recently crossed Blue Mountains. This evidence was also no doubt utilised by previous workers in establishing a typical variety in relation to var. *eremaea* J.M.Black and var. *tomentosa* Hook.f. (e.g. Black 1926, Barker 1986), or by its exclusion from the taxon representing the tomentose form (Hooker 1840).

Of interest is the further comment that this species was different from Robert Brown's collection of a "nearly related, but distinct species" from the south coast, presumably a reference to Brown's collections from Seal Island in King Georges Sound, Western Australia, and from Mt Brown in South Australia. Both of these specimens are entered in the Brown database (Chapman et al. 2001) as *L. plebeia* and need to be re-examined so that they can be correctly named.

Lectotypification of *Lavatera plebeia* var. *eremaea* J.M. Black.

The Richards collection from Euria in the Penong area of South Australia was chosen as lectotype since it is most representative of the taxon and has been annotated with the varietal name by J.M. Black. It consists of the two specimens on the left hand side of the sheet, both of them with flowers and fruits. It is mounted on the same sheet as two of the syntypes: Tate's collection from Gully Bunda Cliffs on the Bight near the Western Australian border, consisting of two small branches with flowers and fruits, and Tepper's collection from Ardrossan on Yorke Peninsula, which consists of four small branches. Both of these syntypes have also been annotated by J.M. Black as var. *eremaea*. The Tepper collection is somewhat atypical for *M. weinmanniana* being particularly hirsute and with very small leaves. Nevertheless, it still falls within the range of variation seen in this species, resembling the occasional salt-stressed plants seen from from Bass Strait and offshore islands in Western Australia.

The other possible syntype in the Black herbarium, collected from Ooldea, has not been annotated as var. *eremaea* by Black and consists merely of a long piece of stem with a single leaf.

Osborn's collection from Franklin Islands near Cowell is an excluded syntype since it represents typical *M. preissiana*; it has been annotated as var. *eremaea* by Black. A specimen from Caroona on Eyre Peninsula has not been found in AD at this time.

3. *Malva arborea* × *M. preissiana*

Occasional sterile hybrids between these two species have been recorded in Western Australia (Rippey 2004). It has been known for some time that the introduced *M. arborea* is replacing the native *M. preissiana* on offshore islands in South Australia, Victoria and Western Australia (Rippey 2004) and so there is a clear need to be able to distinguish between the hybrid and the two parents for those involved in monitoring such changes.

The hybrid can be distinguished easily from both *M. preissiana* and *M. weinmanniana* by having the epicalyx (bracteoles) and calyx lobes of similar length, whereas the epicalyx lobes of the native taxa are shorter than those of the calyx (Table 1). The hybrid also tends to have broader, less apically notched petals with only very faint striping and a darker pink claw, whereas both native species have prominently notched petals and pale greenish-yellow claws (Fig. 1). While the hybrid and *M. weinmanniana* both share pink flowers, the former is much more tomentose overall than *M. weinmanniana,* has an upper leaf surface which is less hairy than the lower and usually bears c. 12 mericarps per fruit.

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A Revision of the genus *Stellaria* (Caryophyllaceae) in Australia

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Abstract

A review of the species of *Stellaria* L. occurring in Australia is provided. The genus is represented by 10 species, of which *S. papillata* C.H.Mill. & J.G.West is described as new, as are 3 subspecies: *S. angustifolia* subsp. *rotundisepala* C.H.Mill. & J.G.West, *S. multiflora* subsp. *collaris* C.H.Mill. & J.G.West and *S. multiflora* subsp. *nebulosa* C.H.Mill. & J.G.West. Two new combinations are made, namely *S. angustifolia* subsp. *tenella* (Benth.) C.H.Mill. & J.G.West, based on *S. glauca* Hook. var. (?) *tenella* Benth. and *S. leptoclada* (Benth.) C.H.Mill. & J.G.West, based on *Stellaria glauca* var. (?) *leptoclada* Benth. Lectotypes are selected for *S. angustifolia* Hook., *S. caespitosa* Hook.f., *S. glauca* Hook. var. (?) *tenella* Benth, *S. filiformis* (Benth.) Mattf., *S. flaccida* Hook., *S. multiflora* Hook., *S. pungens* Brongn. and *S. squarrosa* Hook. Notes, maps, illustrations and an identification key are provided for all taxa occurring in Australia.

Keywords: Caryophyllaceae, *Stellaria*, Australia, revision, taxonomy, nomenclature.

Introduction

This paper is a precursor to the treatment of *Stellaria* L. (Caryophyllaceae) for the *Flora of Australia* series and provides names for four new taxa, as well as typification and nomenclatural information. *Stellaria* consists of about 120 species (Morton 2005) and is found throughout temperate areas worldwide and at higher altitudes in tropical areas. There are a few weedy species, such as *S. media* (L.) Vill. and *S. graminea* L., which are found almost worldwide.

Stellaria belongs to the family Caryophyllaceae Juss., subfamily Alsinoideae Beilschm. Members of this subfamily are distinguished from subfamily Caryophylloideae Arn. by their free sepals and from the subfamily Paronychoideae Meisn. by their exstipitate leaves (Conn 1983; Chater & Heywood 1993; McNeill 1962). The genus is characterised by the presence of five sepals and five petals which are usually bifid; however in some species the petals are markedly reduced or absent. The closest related genera are currently thought to be *Cerastium* L. and *Holosteum* L. (Fior et al. 2006; Harbaugh et al. 2010).

There are currently six endemic species and three introduced species recognised with one further new endemic species and three endemic subspecies being described here. Two additional new combinations have also been made.

In Australia some of the endemic species appear to be closely related and form complexes. The '*angustifolia* group' usually occurs in wetter areas and is morphologically similar to northern hemisphere species, particularly *S. palustris* L. This complex is distinguished by the presence of sessile leaves, five fully-formed bifid petals, ten stamens, and by the absence of staminodes. It currently consists of two species, namely *S. leptoclada* (Benth.) C.H.Mill. & J.G.West, and *S. angustifolia* Hook., the latter with three subspecies. It can be difficult to separate these taxa without good flowering or fruiting material. Two additional species, *S. flaccida* Hook. and *S. pungens* Brongn., have some affinities with the '*angustifolia* group' but are quite distinct, particularly in habit and vegetative characters. A second '*multiflora* group' occurs in dryer or harsher regions such as coastal or inland dunes, on islands or in alpine areas. It is distinguished by the presence of leaves with narrowed and elongated bases so that they often appear petiolate (although they are technically still sessile) and by the reduction in size, form and number of floral structures. This '*multiflora* group' consists of three species: *S. filiformis* (Benth.) Mattf., *S. papillata* C.H.Mill. & J.G.West and *S. multiflora* Hook., the last with three subspecies.

This occurrence of such complexes seems to be common in the genus in the northern hemisphere taxa as well. There have been a number of studies carried out on the North American *S. longipes* Goldie complex using both morphological and molecular analyses. The results from these studies (Chinnappa & Morton 1984; Chinnappa et al. 2005) showed that environmental factors influence key characters such as inflorescence type and the occurrence of scarious bracts. Chinnappa & Morton (1984) stated that "it proved possible to 'change' several of the 'species' into other 'species' simply by altering the environmental conditions under which they were growing" (Chinnappa & Morton 1984;

Table 1. Summary of subgeneric classification schemes for *Stellaria*.

	Fenzel (1840)	Pax & Hoffmann (1934)
Section	b. '*Eustellaria*'	I. '*Eustellaria*'
Subsection	α. *Petiolares*	1. *Petiolares*
Species listed	*S. media*, *S. flaccida*	*S. media*, *S. pallida*
Subsection	δ. *Larbreae*	4. *Larbreae*
Species listed	*S. graminea*	*S. graminea*, *S. palustris*
Subsection	ε. *Spinescentes*	5. *Spinescentes*
Species listed	*S. squarrosa*, *S. pungens*	*S.pungens*
Unplaced species		*S. multiflora*

Chinnappa et al. 2005). Due to this plasticity Morton (2005) decided to adopt a broad concept of *S. longipes* and only recognized one infraspecific taxon. By contrast *S. media* and *S. pallida* are two members of the '*media* group' that, together with *S. neglecta* Weihe, have been variously interpreted as varieties, subspecies or, as here, species following most recent authors such as Chen & Rabeler (2001) and Morton (2005).

Taxonomic History

Stellaria was first described by Linnaeus (1753) with several European taxa listed, including *S. nemorum* L., *S. dichotoma* L., *S. radians* L., *S. graminea*, *S. cerastoides* L., *S. biflora* L. and *S. holostea* L. This last taxon was chosen by Hitchcock & Green (1929) as the type species of the genus. To date there have been no major worldwide revisions; the closest is the synopsis published in *Die Natürlichen Pflanzenfamilien* by Pax & Hoffmann (1934). Most publications have been regional floras such as for the British Isles (Clapham et al. 1952), Europe (Chater & Heywood 1993), China (Chen & Rabeler 2001) and North America (Morton 2005).

Species. The first Australian species of *Stellaria*, *S. pungens* was illustrated and named by Brongniart in 1834, for which no description was provided and currently no specimen has been located. W.J. Hooker (1834) published two species, *S. angustifolia* and *S. squarrosa* Hook., in the same year, two more species, *S. flaccida* and *S. multiflora*, in 1836 (Hooker 1836) and a further species, *S. caespitosa* Hook. in 1840 (Hooker 1840).

The first treatment of the genus for Australia was by Bentham (1863) in which he listed five species. This comprised the introduced species *S. media,* and three endemic species, *S. multiflora*, *S. pungens* and *S. flaccida*. The fifth species listed was the northern hemisphere *S. glauca* With. Bentham included *S. angustifolia* under *S. glauca.* Additionally two infraspecific taxa, *S. glauca* var. (?) *leptoclada* Benth. and *S. glauca* var (?) *tenella* Benth. were published by Bentham. He also described another species, *Drymaria filiformis* Benth. which was later transferred to *Stellaria* (Mattfeld 1938).

During the late 1800's the use of the name *S. glauca* was replaced by the name *S. palustris* Ehrh. ex Retz (Mueller 1887) and this name was in common usage until the later part of the 1900's. During the 1980's until the current day the consensus has been that this taxon is truly Australian and the name *S. angustifolia* has been applied (Doust 1990, Miller & West 1996).

The introduced species *S. graminea* (Curtis 1956) and *S. pallida* (Dumort.) Crep. (Eichler 1965) were first reported as occurring in Australia in the second half of the twentieth century.

No new names for Australian taxa have been published since the first half of the twentieth century; however some informal names have been used in various state floras in the second half of the twentieth century. In this treatment *S. media*, *S. multiflora*, *S. pungens*, *S. flaccida*, *S. filiformis* (Benth.) Mattf., *S. graminea* and *S. pallida* are recognised. *Stellaria multiflora* is divided into three subspecies, two of which are new. *S. angustifolia* is resurrected and divided into three subspecies, one of which is new and one is a new combination based on Bentham's *S. glauca* var (?) *tenella*. Bentham's *S. glauca* var. (?) *leptoclada* is raised to species level. *S. papillata* is newly described for Australia.

Suprageneric classification. Fenzl (1840) published the first suprageneric classification for Caryophyllaceae, which was enlarged upon by Pax & Hoffmann (1934). Many of their tribal and subtribal names have not been used in recent literature (Rabeler & Bittrich 1993) as these classifications were based upon "arbitrary interpretations of morphology" (Bittrich 1993). It has been suggested that convergent evolution of morphological characters, such as reduction or loss of floral parts, makes it difficult to define a clear cut classification (Smissen et al. 2002). Some work has subsequently been done on the higher level classification of Caryophyllaceae using molecular techniques. These studies have shown that while the family Caryophyllaceae is monophyletic, none of the subfamilies as currently defined are and more work needs to be done to determine a phylogenetically robust classification (Smissen et al 2002, Fior et al. 2006). Harbaugh et. al. (2010) have proposed to abandon subfamilies within the Caryophyllaceae and recognize

at least 11 tribes to deal with the polyphyletic nature of the family. They propose to include *Stellaria* in the tribe Alsineae, which agrees with Pax & Hoffmann's (1934) classification.

Subgeneric classification. The infrageneric classification of *Stellaria* was published by Fenzl (1840). This was then expanded by Pax & Hoffmann (1934). All of the Australian species were placed in the section *Stellaria* (as '*Eustellaria*' Fenzl). They included the introduced species *S. graminea*, *S. media* and *S. pallida* as well as the endemic species *S. flaccida* and *S. pungens* in these classifications (Table 1). Pax & Hoffmann (1934) mentioned *S. multiflora* in the biogeographic discussion but did not place the species in their classification. As the majority of the Stellaria species were not included, the classification has not been taken up in Australian literature.

Morphology

Leaves. In the family Caryophyllaceae the leaves are most commonly opposite, decussate, usually sessile or subsessile or sometimes petiolate (Bittrich 1993). In Australia, the *Stellaria* species have leaves that are either sessile, as in the majority of the '*augustifolia* group', *S. pungens* and the introduced species *S. graminea* or appearing petiolate, as in the majority of the '*multiflora* group' and *S. flaccida*, similar to what occurs in the introduced species *S. media* and *S. pallida*. On the narrow petiolate portion of the leaf there is always some tissue so it is not truly a petiole. There is a tendency that the petiolate nature of the leaf is more pronounced towards the base of the plant and this shortens and the leaf becomes sessile towards the apex and particularly in the flowering sections of the plant.

Leaf shapes in the family range from linear, needle shaped or grass-like to broadly ovate; some are rigid and acute or even spiny at the apex (Bittrich 1993). In the Australian *Stellaria* species the leaf shape has an even greater variation, ranging from filiform, linear, elliptic, ovate, obovate, as well as variation in width from narrow to broad. This character needs to be used with caution as the leaves can become progressively longer and narrower as the plant develops (Chinnappa & Morton 1984). In Australia the only species that may become rigid and has a spiny apex is *S. pungens*.

In the transition from the vegetative to the flowering parts of the plant either of two leaf states occurs. In the first state which is listed in the keys and descriptions as 'Leaves a continuous series', the structures subtending the flowers, which are technically bracts, appear the same as the lower leaves and one cannot distinguish between them as they remain the same texture, colour and shape but they gradually become smaller and, if petiolate, this becomes shorter and even sessile towards the extremities of the plant. The alternative character state which is listed in the keys and descriptions as 'Leaves not a continuous series' is characterized by the abrupt change from leaves to bracts where the size is markedly reduced, they are always sessile and the texture usually changes from green and leafy to white and scarious. However, one must be cautious in applying absolute values to leaf shape and size as it has been observed that these characters can be altered by altering environmental factors (Chinnappa & Morton 1984).

Inflorescence structure. In the Caryophyllaceae the inflorescence can be few to many flowered determinate (monotelic) thyrses, partial inflorescences that are mostly dichasia, or more rarely monochasia (Bittrich 1993). In the Austalian *Stellaria* species the most common inflorescence states are a monochasium, a few flowered partial monochasium or one to two flowered. Only larger specimens of *S. angustifolia* and all specimens of *S. filiformis* have the more common family character of dichasia, while all three introduced species, S. *graminea*, *S. media* and *S. pallida*, also have a dichasial inflorescence.

This type of inflorescence can cause problems in interpretation since the type of inflorescence can change as the plant matures, particularly from a single or few-flowered state to the partial monochasium to a many flowered monochasium. In the North American species, *S. longipes*, research has found that environmental factors can influence the number of flowers in the inflorescence and the development of the scarious floral leaves or bracts (Chinnappa & Morton 1984). The second character, the development of the scarious bracts, has not been observed to change in the only Australian species, *S. filiformis*, that has this character state. This study found that flower size was not affected by changing environmental conditions and is a good character to use when determining species.

Floral structures. In the Caryophyllaceae the flowers are generally actinomorphic and normally consist of three, four or five tetra- or pentamerous whorls (Bittrich 1993). In *Stellaria* there are five sepals with most commonly five petals which are usually deeply bifid. The stamens are usually in one or two whorls of five, and while the number may be reduced or supplemented with staminodes the total number is never more than ten.

In Australia there are two flower types. The first flower type is correlated with the '*angustifolia* group', *S. flaccida*, *S. pungens* and the introduced species *S. graminea.* These have five sepals, five deeply bifid petals about the same length as the sepals and ten stamens in two whorls and no staminodes. This is the same pattern found in many of the Northern hemisphere taxa. The second type is correlated with the '*multiflora* group' and the introduced species *S. media* and *S. pallida.* These have five sepals, five or less bifid petals that are small, usually less than half the length of the sepals, or reduced to small fragments or totally absent. There are usually two to five stamens and zero to five staminodes, except for subsp. *multiflora* and subsp. *nebulosa* which have three to ten stamens. When there are five or less stamens

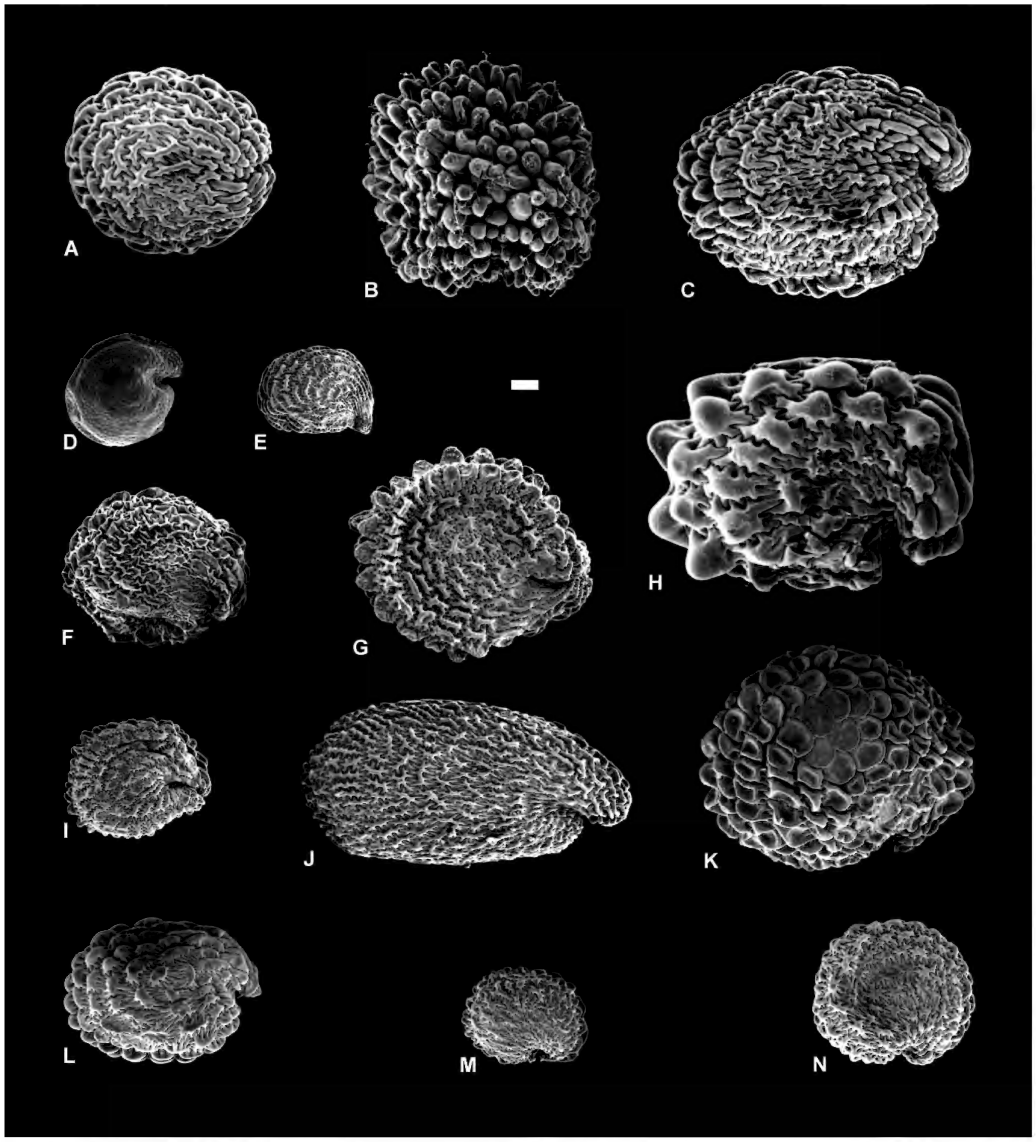

Fig. 1. SEM of seeds. A–C *Stellaria angustifolia*: **A** subsp. *angustfolia*; **B** subsp. *rotundisepala*; **C** subsp *tenella*. **D** *S. filiformis*. **E** *S. graminea*. **F** *S. leptoclada*. **G** *S. media*. **H** *S. flaccida*. **I** *S. pallida*. **J** *S. papillata*. **K** *S. pungens*. **L–N** *S. multiflora*: **L** subsp. *multiflora*; **M** subsp. *collaris*; **N** subsp. *nebulosa*. Scale bar: 100µm. — **A** *A.C. Beauglehole 82200* (CANB 364207); **B** *J.H. Willis s.n.* (MEL 501962); **C** *R.A. Black s.n.* (MEL 1579640); **D** *A. Cooper s.n.* (NSW 145525); **E** *A.H.S. Lucas s.n.* (NSW 29863); **F** *R. Coveny et. al.* 8954 (NSW 298626); **G** *C.H. Miller & J. Palmer 590* (CANB 409321); **H** *W.M. Curtis s.n.* (HO 29492); **I** *C.H. Miller & J. Palmer 603* (CANB 409333); **J** *J. Carrick 3135* (AD 97207083); **K** *J. McKean WL 5189* (CANB 327583); **L** *L.G. Adams 1644* (CANB 166831); **M** *H.S. McKee 11668* (CANB 319264); **N** *J.S. Whinray 1150* (CANB 442426).

present they are positioned opposite the sepals and have a slightly enlarged base.

Fruits and Seeds. There are two to five or rarely more styles, free to the base and clearly distinct from the ovary, a character that occurs throughout the subfamily Alsinoideae (Bittrich 1993). In *Stellaria* the style number is usually three, rarely two, four or five. This also holds for the Australian species where it is extremely rare to find more than three styles.

For the tribe Alsineae the fruit is a capsule that normally opens with valves or teeth equal to or twice

the number of carpels, or is rarely indehiscent (Bittrich 1993). In *Stellaria* the number of valves is twice the number of carpels and in the Australian species this is six, very rarely more. The surface texture of the capsule valves is usually translucent to opaque and relatively smooth. There is one species in Australia, *S. papillata* that has the surface covered in distinct papillae. On maturity the valves split, usually for more than half their length or almost to the base and the apices of the valves displace, either moving only slightly outward so the valves remain almost straight, the apices curve out so they are recurved or the valves curl completely around to be revolute. Also the valve alignment can either remain in place, retaining the capsule shape or displace outwards, giving a spreading appearance. Capsule characters such as colour and angle of the valves have been shown to be defining characters as they are not affected by environmental factors (Chinnappa & Morton 1984).

In *Stellaria* the seeds are small (0.4–3 mm long), numerous, rarely few or one, roundish to reniform, usually laterally compressed and the testa is variously sculptured by more or less papilliform cells, rarely completely smooth (Bittrich 1993). In Australia, *Stellaria* has these seed characters and further study is needed to determine reliable characters to separate the taxa. The cell shape is always stellate, although this can be sometimes hard to see, particularly in *S. filiformis* (Fig. 1D), which has a very small, light-coloured seed, c. 0.5 mm long, that has a semi translucent testa and is smooth with small raised pits in the middle of the cells. The rest of the taxa have well defined stellate cells that are often inflated in the centre to form either a ridge when the cell is long and thin, such as *S. papillata* (Fig. 1J) and *S. angustifolia* subsp. *angustifolia* (Fig. 1A), or hills when the cell shape is more rounded, such as *S. multiflora* subsp. *nebulosa* (Fig. 1N). The cells are much more raised on the outer dorsal surface of the seeds. In some cases these inflated cells become almost finger-like, such as in *S. flaccida* (Fig. 1H) and *S. pungens* (Fig. 1K), and in an extreme case the finger-like projections cover the entire seed so that the stellate cell shape can no longer be seen, such as in *S. angustifolia* subsp. *rotundisepala* (Fig. 1B), which is not seen in any other taxa in Australian *Stellaria*. The introduced species, *S. media* (Fig. 1G) and *S. pallida* (Fig. 1I), also have the addition of small papillae on the arms of the stellate cells, a character that is not present in any of the Australian species of *Stellaria.*

From the North American *S. longipes* study none of the morphological characters was shown to be associated with polyploidy; nor was there any consistent association between chromosome number and geographic distribution (Chinnapa et al. 2005). From this study it was shown that the Arctic populations were generally low, single flowered plants lacking scarious bracts, while progressive development in internode length, flower number and presence of scarious bracts were observed in more southerly populations. In Australia *Stellaria* is restricted to the southern part of the continent and no obvious association can be observed between morphological traits and latitude. There may be reason to think that the predominance of the monochasial inflorescence is due more to the harsher, drier environmental conditions found in Australia rather than a difference in latitude. The presence of scarious bracts is only found in the Australian species *S. filiformis* which has a distribution across the southern part of Australia from Wyalong in New South Wales to Cowcowing in Western Australia in sandy soils with high summer temperatures and low rainfall. There are more of the monchasial species, such as those in the '*angustifolia* group' and the '*multiflora* group' that grow both north and south of *S. filiformis*.

Typifications

Ronald C. Gunn and Robert W. Lawrence collections from Tasmania. Some of the type material for the Australian *Stellaria* species is from collections made by Gunn and Lawrence in Tasmania. Due to a number of peculiarities of their collecting and recording methods some difficulties have arisen in determining type material. The numbers on Gunn and Lawrence labels refer to their species numbers and not collecting numbers. There is often more than one collection that has the same number but different collection dates. Where there is only a year written on the label this indicates the year of dispatch of the parcel to London and not the actual collection date of the collection. There are cases where there is also a full collection date on the same label and this is later than the dispatch date as the parcel was sent later than expected. Some of these collections were collected by other people and Gunn arranged these collections within his own numbering system (Buchanan 1988).

Collections from England. All material from K and BM was searched for types. Many of the names published by Bentham are typified with material from Herb. Hookerianum (K), often annotated by Bentham. No type specimens were found in Bentham's own Herbarium (Herb. Benthamianum, K).

Materials & methods

This review has been based on dried material from the following herbaria: AD, BM, BRI, CANB (incl. CBG), CHR, DNA, HO, K, LD, MEL, NSW, OXF and PERTH. Limited field work was undertaken in New South Wales, the Australian Capital Territory, Victoria and New Zealand.

For Scanning Electron Microscopy (SEM), Fig. 1, seeds were mounted onto 10 mm diameter metal stubs using double sided tape. All samples were coated with gold before observation in a Jeol 6400 Scanning Electron Microscope at an accelerating voltage of 15kV. Images taken using B&W polaroid camera. Facilities provided by the CSIRO Black Mountain Microscopy Centre, A.C.T.

Taxonomic Treatment

***Stellaria* L.**

Sp. Pl. 1: 421 (1753). — Type species: *S. holostea* L., *fide* Hitchcock & Green, *Prop. Brit. Bot.*: 155 (1929).

Annual or perennial herbs, glabrous or sparsely hairy. *Leaves* opposite; stipules absent; floral leaves herbaceous to scarious. *Flowers* in spreading dichasia to partial monochasia, or solitary or 2-flowered, 5-merous, bisexual. *Sepals* 5, free, usually narrow to broadly ovate. *Petals* usually 5, free, bifid, shorter to longer than sepals, in some taxa reduced or absent. *Stamens* 1–10. *Staminodes* 0–5. *Ovary* 1-celled; styles 3, free to base; *placentation* free-central. *Fruit* a conical capsule, splitting to middle or below, 6-valved. *Seeds* 2 to many, subdiscoid to nautiloid to obloid; testa minutely to prominently tuberculate.

Distribution & habitat. A genus of about 120 species (Morton 2005) found throughout temperate areas worldwide and at higher altitudes in tropical areas. There are a few weedy species, such as *S. media* and *S. graminea* that occur almost worldwide.

In Australia *Stellaria* is represented by 10 species including both endemic and introduced elements. The genus is distributed in temperate areas from southern Queensland, throughout New South Wales, Victoria, Tasmania, the southern parts of South Australia and Western Australia and central parts of the Northern Territory. There are three introduced species of which two, *S. media* and *S. pallida*, have become naturalised and distributed throughout the native range of the genus in Australia and extend northwards to the tropics in Queensland, the Northern Territory and Western Australia. A third introduced species, *S. graminea*, has a very localised distribution in alpine areas of New South Wales and Victoria, subalpine areas in Tasmania, and the hills of southern Fleurieu Peninsula, South Australia.

Stellaria is found in a wide range of habitats in Australia from coastal dunes, heathlands, grasslands, herblands, swamps, fern communities in gully forests, underlying open eucalypt or *Callitris* woodlands, rainforests, alpine bogs, mallees and Chenopodiaceae or *Leptospermum* scrublands. The endemic species are often associated with wetter areas such as watercourses, areas that seasonally flood, drainage areas or dams. The weedy species are often associated with disturbed areas such as roadside drains, dams or cultivated areas. They can grow in a wide variety of soil types from sands to clays and on almost any rock type.

The native Australian species of *Stellaria* are endemic and do not occur in nearby countries such as New Zealand and Papua New Guinea. New Zealand has five native species and four introduced species (Webb et al. 1988). Two of their introduced taxa, *S. media* and *S. graminea*, also occur in Australia. One of the Australian species, *S. flaccida*, shows affinities with the New Zealand endemic *S. parviflora* Hook.f. Much less is known about the flora of Papua New Guinea, with only one introduced species, *S. media*, and one native species, *S. stellatopilosa* Hayata, present (van Royen 1982). *S. stellatopilosa* appears to have affinities with *S. decipiens* Hook.f. from New Zealand.

Etymology. The name derives from the Latin *stella* (a star) and *aria* (connected with), an allusion to the radiating, deeply bifid petals.

Note. Species are treated here in alphabetical order as there is no satisfactory infrageneric treatment available at this time.

1. *Stellaria angustifolia* Hook.

J. Bot. (Hooker) 1: 250 (1834). **— Type citation:** ”Mr. Lawrence, Formosa, (n. 241,) Mr. Gunn, (n. 238.)”. **Lectotype (here designated):** Formosa, Lawrence n. 241, Aquatic (K, Herb. Hooker p.p. [3 pieces to the right hand side of the pencil line]). **Isolectotype:** RWL[awrence] 241, Aquatic. (NSW). **Residual Syntypes:** [Gunn] 238, 1833 (NSW p.p.); Gunn’s Herbarium of Tasmanian Plants. (n. 238). (NSW p.p.).

Stellaria caespitosa Hook.f., J. Bot. (Hooker) 2: 411(1840). — *Stellaria glauca* var. (?) *caespitosa* (Hook.f.) Benth. Fl. Austral. 1: 158 (1863). — **Type citation**: “In a marsh at Circular Head. *Mr. Gunn* (n. 652 and 653?)”. **Lectotype (here designated):** In a marsh at Circular Head, *Gunn* 652?, 1837 (K, Herb. Hooker p.p. [2 pieces on the top right hand side of the pencil line]).

Stellaria palustris auct. non Ehrh. ex Retz.: F.Muell., Key Syst. Victorian Pl. 1: 166 (1887); C.Moore, Handb. Fl. N.S.W. 99 (1893); W.A.Dixon, Pl. N.S.W. 77 (1906); J.M.Black, Fl. S. Austral. 2: 231 (1924); Ewart, Fl. Victoria: 491 (1931); J.H.Willis, Handb. Pl. Victoria 2: 136 (1972); W.M.Curtis, Stud. Fl. Tasman. 1: 70 (1975); K.Chorney in Jessop & Toelken, Fl. S. Austral. 1: 235 (1986).

Stellaria glauca auct. non With.: Benth., Fl. Austral. 1:158 (1863); Tate, Handb. Fl. Extratrop. S. Austral. 43 (1890); F.M.Bailey, Queensl. Fl. 1: 87 (1899).

Annual or perennial, stems tall and slender to spreading or prostrate, with slender rhizome which may root from nodes; stems (5–) 11–60 (–90) cm long, usually single stemmed or branching from base, glabrous to scabrous. *Stem and inflorescence leaves* forming continuous series, sessile, not clasping, narrowly ovate, linear, narrowly elliptic or narrowly obovate, (3.5–) 10–40 (–60) mm long, 0.9–3 (–3.9) mm wide, apex acute to subacute, rarely obtuse, margin entire, rarely recurved, glabrous to scabrous all over, sometimes with 2–5-celled hairs on margins. *Inflorescence* axillary and solitary, interrupted monochasia of 2–7 flowers, monochasia of 5–7 flowers or rarely dichasia of 7–23 flowers. *Pedicels* (15.5–) 20–72 (–90) mm long, slender, erect in fruit, glabrous to scabrous, often quadrangular, ridged or grooved. *Sepals* 1.5–8 (–9) mm long, acute to acuminate, obtuse, or folded over to form hood, sometimes with hood thickened, the margin entire, rarely minutely ragged. *Petals* 2.4–7.5 (–9) mm long, usually about equal to sepals to twice sepal length; bifid to deeply bifid. *Stamens* 10. *Staminodes* 0. *Styles* 0.8–4 (–5.3) mm long. *Capsule* ellipsoid to ovoid, (2.8–) 3.5–6.8 (–8.5) mm long, (1.8–) 2.4–4 (–5) mm wide, from

Key to Species of *Stellaria* in Australia

1. Leaves sessile but lower leaves at least, appearing petiolate
  2. Internodes with single line of hairs for entire length
    3. Petals present; fertile stamens 3–5, rarely 2; all seeds dark in colour, usually > 1 mm long . . . . . **6. * *S. media***
    3: Petals absent; fertile stamens 2, rarely more; at least some seeds pale to midbrown, < 1 mm long . . . . . **8. * *S. pallida***
  2: Internodes without single line of hairs
    4. Petals present, > ½ sepal length, > 2 mm long
      5. Plant erect, fine-stemmed, to 20 (–30) cm long; sepals glabrous; fruit < 5 mm long, < 2.5 mm wide . . **5. *S. leptoclada***
      5: Plant lax, to 50 cm long; sepals with hairs or ciliate along some margins, often hairs also on sepal back or midrib; fruit > 5 mm long, > 2.5 mm wide . . . . . **3. *S. flaccida***
    4: Petals absent or if present, < ½ sepal length, < 2 mm long . . . . . **7. *S. multiflora***
1: Leaves sessile
  6. Petals absent or if present < ½ sepal length, < 2 mm long
    7. Inflorescence a dichasium; stem leaves in basal rosette, filiform, herbaceous to fleshy; floral leaves linear to ovate to lanceolate, usually scarious; seeds with minute tubercles, appearing smooth (Fig. 3a–g) . . . . . **2. *S. filiformis***
    7: Inflorescence axillary and solitary or a monochasium; leaves in continuous series, stem leaves not in basal rosette and not filiform; floral leaves herbaceous, never scarious; seeds with prominent tubercles, appearing reticulate (Fig. 3h–n)
      8. Capsule valves thick, opaque, covered with angular papillae; seeds obloid to ellipsoid, 1–2 per capsule, 1.3–1.9 mm long . . . . . **9. *S. papillata***
      8: Capsule valves thin, semitransparent, smooth; seeds suborbicular or kidney-shaped or broad-ellipsoid, more than 2 per capsule, < 1.3 mm long . . . . . **7. *S. multiflora***
  6: Petals present, > ½ sepal length > 2 mm long
    9. Flowers 5 or more, usually either a monochasium or dichasium
      10. Stems, leaves and sepals sparsely to densely covered with long curly hairs; leaf apex usually pungent; sepal apex usually pungent, never hooded . . . . . **10. *S. pungens***
      10: Stems, leaves and sepals glabrous, scabrous or if hairs present then these not long or curly; leaf apex acute to subacute, never pungent; sepal apex acute to obtuse, never pungent, hooded or not
        11. Leaves not a continuous series; floral leaves much smaller, scarious, sparsely to densely ciliate along entire length; outer sepals often ciliate along entire length; sepal apex not hooded; inflorescence a dichasium . . . . . **4. * *S. graminea***
        11: Leaves a continuous series; floral leaves herbaceous, glabrous, scabrous or with short hairs basally; sepals glabrous or scabrous; sepal apex hooded or not; inflorescence a monochasium, an interrupted monochasium or solitary, rarely a dichasium
          12. Stems usually glabrous to scabrous; leaves never in basal rosette; sepal apex straight, rarely hooded; seed usually > 1 mm long . . . . . **1. *S. angustifolia*** (mostly subsp. ***angustifolia***)
          12: Stems sparsely covered with short hairs or scabrous; leaves often arising from loose basal rosette; sepal apex straight, not hooded; seeds usually < 1 mm long . . . . . **5. *S. leptoclada***
    9: Flowers usually solitary, rarely 2–3-flowered
      13. Stems, leaves and sepals sparsely to densely covered with long curly hairs; leaf apex acute to pungent; sepal apex acute to pungent, never hooded . . . . . **10. *S. pungens***
      13: Stems, leaves and sepals glabrous, scabrous or rarely some margins with short hairs; leaf apex acute to subacute, not pungent; sepal apex acute to obtuse, not pungent, hooded or straight . . . . . **1. *S. angustifolia*** (mostly subspp. ***rotundisepala*** and ***tenella***)

1/3 shorter to 4 times longer than sepals; *valves* straight to spreading, apex straight, recurved to revolute, rarely twisted sideways. *Seeds* 2–33, suborbicular to ellipsoid, flattened top and bottom, (0.5–) 0.8–1.2 (–1.4) mm long, light brown to grey brown to reddish brown or purplish, tubercles ridged, wrinkled to rounded and narrow, spiny in appearance.

Distribution. A widespread endemic species in temperate Australia, from southern Queensland, throughout New South Wales, Victoria, southern South Australia (including Kangaroo Island) and Tasmania.

Notes. Further study of this taxon is much needed. Historically, this taxon has been referred to the European species either *S. palustris* or *S. glauca* (a synonym of *S. palustris*) in the Australian literature. Bentham (1863) noted instances where the Australian plants differed from the European specimens, but retained the taxon in *S. glauca* and placed *S. angustifolia* in synonymy. He also reduced *S. caespitosa* to a variety under *S. glauca*. Other authors have used *S. palustris* and have also used Bentham's infraspecific taxa, but at different ranks.

Stellaria palustris specimens from England and northern Europe have erect, linear leaves on the stems and floral leaves that are markedly shorter, ovate to narrowly ovate and often scarious and the inflorescence is usually a terminal dichasial cyme. *S. angustifolia* specimens have linear to lanceolate leaves, floral leaves which are in a continuous series, and the inflorescence can be axillary and solitary, or an interrupted monochasium, a monochasium or occasionally a dichasium in larger plants. As the species can usually be distinguished from each other, *S. angustifolia* is treated here as a separate entity from the widespread European taxon *S. palustris*.

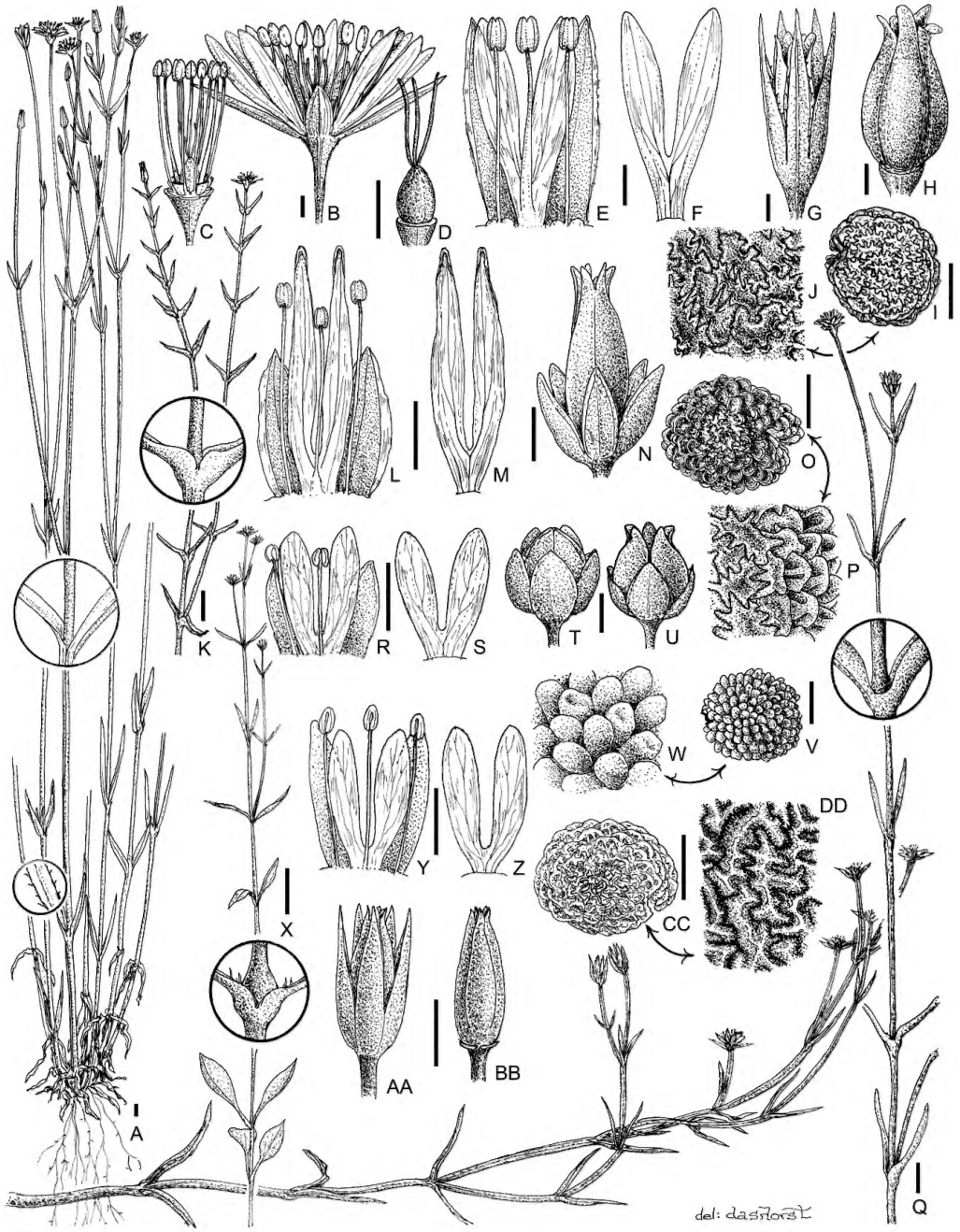

Fig. 2. A–J *Stellaria angustifolia* subsp. ***angustifolia***: **A** habit; **B** flower; **C** flower with petals & sepals removed; **D** gynoecium; **E** part of flower showing sepal, petal and stamen arrangement; **F** petal; **G** capsule showing position in relation to sepals; **H** mature capsule; **I** seed, side view; **J** seed coat cell detail. **K–P *S. angustifolia*** subsp. ***tenella***: **K** habit; **L** part of flower showing sepal, petal and stamen arrangement; **M** petal; **N** capsule; **O** seed, side view; **P** seed coat cell detail. **Q–W *S. angustifolia*** subsp. ***rotundisepala***: **Q** habit; **R** part of flower showing sepal, petal and stamen

It is evident that the taxa in the '*angustifolia* group' are closely related, particularly in their vegetative characteristics. The taxon which has been consistently referred to as var. *tenella* can be separated from other plants by its smaller size, mat forming habit with short internodes, sepals that end in a hooded structure, petals that are usually about twice the sepal length and flowers that are almost always solitary and axillary. However, under favourable growing conditions the plants can become larger, more erect and with longer internodes and more flowers. The plants at the smaller end of the spectrum can for the most part be readily separated and match well with the type specimens of var. *tenella*. Bentham (1863) compared var. (?) *tenella* to var. *caespitosa*, but commented that *tenella* is smaller and much more slender, with crowded, very small leaves.

Applying the epithet var. *caespitosa* to plants is more problematic as most of the characters used are size related and this is very dependent on the environmental conditions in which the plants grow. Examination of the type specimen of *S. caespitosa* has revealed that the plants have more characters in common with the type specimen of *S. angustifolia* than the type specimen of var. *tenella*. They are closer in size and there are more flowers per plant, the leaves are similar in shape, and while the growth is sometimes mat-forming, the leaves never seem to be as fine as those of *var. tenella*. The sepals are often subacute and slightly hooded especially in bud, but they can usually be differentiated from var. *tenella* plants, particularly when in fruit. We feel that var. *caespitosa* is toward the smaller end of the *S. angustifolia* spectrum, but there are not enough consistent characters to warrant the separation of the taxon from *S. angustifolia*. Bentham (1863) considered *S. glauca* var. *caespitosa* distinct in its inflorescence characters but commented that specimens showed "a very gradual passage" towards *S. glauca* in leaves as well as sepals.

Bentham's taxon var. (?) *leptoclada* is always recognisable from the other taxa in its growth form and inflorescence structure as well as its limited distribution, and has been raised to species level here.

Nomenclatural notes.

Stellaria angustifolia Hook. One sheet from Herbarium Hookerianum held at K contains type material. The sheet has two collections. The first label on the right hand side of the pencil line is 'Aquatic Formosa. Van D's Land. n. 241. Lawrence'; it matches the protologue and locality information and is thus designated as the lecotype. A separate label with 'Arenaria L.R.' is a Cunningham collection from the Lachlan River in NSW and is not type material.

Three sheets from NSW contain type material. The first sheet has three collections with the following labels; '238/1833', '238/1842 Marsh Formosa 7/12/42' and '238/1842 Marlborough 5/1/41'. Only the specimen with the label '238/1833' has been designated as a residual syntype as the other specimens post-date publication. The second sheet has a single plant with the label 'RWL[awrence] 241 aquatic' on it and it has been designated as an isolectotype. The third sheet has the label 'Gunn's Herbarium of Tasmanian Plants 238' and has been designated as a residual syntype.

Stellaria caespitosa Hook.f. One sheet from Herb. Hookerianum held at K contains type material. The sheet has three collections. Only the collection on the top of the sheet on the right hand side of the pencil line with the label ' In a marsh at Circular Head, Gen 652?, 11 Jan 1837' matches the protologue and is here designated as the lectotype. The collection with the label ' Oatlands, [Gunn] 652, Nov 1835 also contains line drawings of floral and seed characters drawn by Hooker. The sepal illustrated is a typical *S. angustifolia* shape with an acute apex which contradicts Hooker's description of *S. caespitos*a which is "calycibus ovato-lanceolatis subacutis".

Key to subspecies of *S. angustifolia*

1. Sepals (3–) 4–8 (–9) mm long, apex acute to acuminate; petals (3.5–) 4.5–7.5 (–9) mm long, about equal to sepals; fertile stamens > 3 mm long. . . . . **a.** subsp. ***angustifolia***

1: Sepals 1.5–2.5 mm long, apex folded over to form hood; petals 2–3.2 (–3.9) mm long, longer than to twice sepal length; fertile stamens < 3 mm long

2. Sepals narrow ovate to elliptic, apex obtuse or acute, hood never thickened; pedicel usually < 20 mm long; seed tubercles semi-inflated ridges. . . **b.** subsp. ***tenella***

2: Sepals round or broad elliptic, apex obtuse, hood sometimes thickened; pedicel > 20 mm long, seed spiny, with narrow, pointed prominent tubercles. . . . . **c.** subsp. ***rotundisepala***

1a. *Stellaria angustifolia* Hook. subsp. *angustifolia*

Illustration. C.H.Mill. & J.G.West in N.G.Walsh & Entwisle, Fl. Victoria 3: 236, Fig. 45e–f (1996), as *S. angustifolia*.

Annual or perennial, weak to tall and spreading to 75 (–90) cm long, glabrous to scabrous. *Stem and inflorescence leaves* as a continuous series, sessile, linear, narrowly ovate to lanceolate, rarely obovate (9–) 10–40 (–60) mm long, 0.9–3 (–3.9) mm wide, acute or rarely subacute, margin rarely recurved, occasionally with short hairs. *Inflorescence* solitary, an interrupted monochasium, monochasium, or rarely a dichasium. *Pedicels* (15.5–) 20–72 (–90) mm long, slender, erect in fruit. *Sepals* narrowly to broadly ovate or elliptic, (3.5–) 4–8 (–9) mm long, acute to acuminate. *Petals* (3.5–)

arrangement; **S** petal; **T–U** flower with immature (**T**) and mature (**U**) capsule; **V** seed, side view; **W** seed coat cell detail. **X–DD *S. leptoclada***: **X** habit; **Y** part of flower showing sepal, petal and stamen arrangement; **Z** petal; **AA** flower showing capsule; **BB** mature capsule; **CC** seed, side view; **DD** seed coat cell detail. Scale bars: habits (**A**, **K**, **Q**, **X**) 5 mm; flowers & fruits 1mm; seeds (**I**, **O**, **V**, **CC**) 0.5 mm. — **A**, **E–H** *R. Schodde 1224* (AD 96227132); **B–D** *D. Hunt 2876* (AD 96913165); **I–J** *Bushman 214* (AD 98232306); **K–P** *R. Bates 21927* (AD 99010076); **Q–W** *R.J. Bates 27162* (AD 99206284); **X–DD** *J.R. Hosking s.n.* (CANB 00710190).

4–7.5 (–9) mm long, usually about equal to sepals; bifid. *Stamens* 10, filaments 3.3–6 (–6.5) mm long. *Staminodes* 0. *Styles* 2.2–4 (–5.3) mm long. *Capsule* ellipsoid to ovoid, (2.8–) 3.5–6.8 (–8.5) mm long, (2–) 2.5–4 (–5) mm wide, shorter than to equal to sepals or sometimes slightly longer; *valves* straight to spreading, apex straight, recurved to revolute, rarely twisted sideways. *Seeds* 8–33, suborbicular to ellipsoid, (0.6–) 0.8–1.2 (–1.4) mm long, light brown to grey brown to reddish brown; tubercles semi-inflated ridges. **Fig. 1A, 2A–J.** Flowering: Sep.–Mar.

Distribution and habitat. The taxon is widespread in southeastern Australia. It occurs south from Stanthorpe in Queensland, as well as west in the Warrego and Darling River systems. In New South Wales, it occurs along the Great Dividing Range from Armidale, through the Blue Mountains, along the Southern Highlands and alpine areas of Kosciuszko National Park. In Victoria, it also occurs in alpine areas along the Great Dividing Range and as far south as Port Phillip as well as to the west across mountain areas and in the Delatite, Delegate and Dry River systems. It also occurs along entire length of the Murray River system. It is rare in Tasmania where it occurs in the Ouse River system. In South Australia, it occurs in higher altitudes, in the Mt Gambier area, as well as the entire length of the Mt Lofty Ranges to Fleurieu Peninsula and Kangaroo Island (Fig. 6A).

Locally common, widespread herb growing in wet areas amongst grasslands, herblands, sedgelands, lignum thickets in swamps, along watercourses particularly after flooding or underlying in open woodlands or *Acacia* or eucalypt forest; rarely in disturbed areas such as roadside drains or dams. Most commonly found in higher altitude areas of ranges above 500 m, rarely found at sea level, where it is associated with large rivers. Grows in rich soils of basalt origin or deep cracking clays through to light sandy soils derived from granites.

Selected specimens (of c. 300 seen)

Queensland: Darling Downs, 6 km N of Goondiwindi, 8 Sep. 2001, *A.R. Bean 17796* (CANB); Darling Downs Wyberba, 30 Dec. 1962, *S.T. Blake 21994* (MEL, NSW); Warrego District, Currawinya National Park, S end of Corni Paroo Waterhole, 17 Sep. 1992, *R.W. Purdie 4151* (CANB).

New South Wales: North Western Plains, 7.5 km N of Bruxner Highway at Yetman on road to Yelarbon, 7 Oct. 1990, *R.G. Coveny & R.O. Makinson 14480* (CANB, MEL, NSW); Ca 10 miles S of old Jindabyne, 8 Jan. 1963, *C.W.E. Moore 3594* (CANB, NSW); 'Winbar' about 40 miles S of Louth (Tundulya block area near mill), 28 Sep. 1976, *C.W.E. Moore 7390* (CANB); Black Swamp, 55 km N of Deniliquin, Oct. 1974, *W.E. Mulham 791* (NSW).

Australian Capital Territory: Cotter River district, Between Jack's Creek and the Cotter River, 14 Dec. 1960, *R. Schodde 1224* (AD, CANB, NSW).

Victoria: Barmah State Park, Murray Valley Study area Sector F, subblock 40B, 18 Nov. 1985, *A.C. Beauglehole 82200* (CANB, MEL, NSW); E. Highlands, Wonnangatta Stn., upstream from Dry Rv. S17, 7 Jan. 1993, *E.A Chesterfield 3570* (CANB, MEL); Dargo High Plains, 17 Jan. 1990, *J. Strudwick 804* (MEL).

Tasmania: Central Highlands, Wihareja Lagoon 9 km NE of Waddamana, Feb. 1984, *A. Moscal 6571* (HO); Stone Hut, between Ouse River and Great Lake, 25 Jan. 1980, *J.J. Yates s.n.* (HO).

South Australia: Kangaroo Island, Ravine des Casoars, s.dat., *R.J. Bates 30356* (AD, CANB); Murray, Upper Saunders Creek Gorge, s.dat., *R.J. Bates 35608* (AD, CANB); Southern Mount Lofty Range, ca 2 km S of Spring Mount Trig point, which is ca 8 km SE of Myponga (Myponga is near coast, ca 55 km SSW of Adelaide), 23 Nov. 1966, *E.A. Shaw 734* (AD, CANB, NSW).

1b. *Stellaria angustifolia* subsp. *tenella* (Benth.) C.H.Mill. & J.G.West, *comb. nov.*

Stellaria glauca With. var. (?) *tenella* Benth., Fl. Austral. 1: 158 (1863). — *Stellaria palustris* Retz. var. *tenella* (Benth.) J.M.Black, Fl. S. Austral. 2: 231 (1924). — **Type citation:** "Victoria. Near Melbourne, *Adamson*; Glenelg river, *Robertson.* Tasmania. Derwent river and Kitt's Group in Bass's Straits, *R. Brown*; granite rocks in St. Patrick's river, *Gunn*". **Lectotype (here designated):** Victoria, Glenelg river, Robertson (K, Herb. Hooker). **Residual syntype:** Victoria. Melbourne, *F. Adamson*, 17/4/[18]53 (K, Herb. Hooker). **Excluded syntypes:** *R. Brown*, Derwent River (BM, K p.p.); V. D. Land, *Gunn 652*, St Patrick's River 16/11/[18]44 (K, Herb. Hooker). — see *S. multiflora*.

Arenaria axillaris Luehm. ex Ewart, Victorian Naturalist 23: 42–43 (1906). — *Stellaria glauca* var. *axillaris* (Luehm. ex Ewart) Ewart, Proc. Roy. Soc. Victoria 19(2): 34 (1907). — **Type Citation**: "Mr. St. Eloy D'Alton, C.E.; from a peat swamp near Dimboola". **Holotype:** MEL, n.v. **Isotype:** NSW 117582.

Stellaria caespitosa auct. non Hook.f.: C.H.Mill. & J.G.West in N.G.Walsh & Entwisle, Fl. Victoria 3: 235 (1996).

Illustration. C.H.Mill. & J.G.West in N.G.Walsh & Entwisle, Fl. Victoria 3: 236, Fig. 45h–i (1996), as *S. caespitosa*.

Annual, spreading mat, straggly or shortly erect herb to 14 (–20) cm long, with many short, vegetative side shoots, rooting at nodes, glabrous or rarely scabrous. *Stem and inflorescence leaves* a continuous series, sessile, lanceolate, narrowly ovate or linear, often falcate, (1.5–) 2–10 (–17.5) mm long, (0.4–) 0.6–1.5 (–2.3) mm wide, acute. *Inflorescence* axillary and solitary or rarely 2 flowers on same stem. *Pedicels* (2.7–) 6–14.5 (–20) mm long, usually deflexed in mature fruit. *Sepals* elliptic to ovate, (1.3–) 1.6–2 (–2.4) mm long, obtuse or acute, apex folded over to form a hood, hood 0.1–0.45 mm long, sometimes margins minutely serrate or ragged. *Petals* 2–3.2 (–3.9) mm long, slightly longer to twice sepal length, deeply bifid. *Stamens* 10, rarely 1 or 2 missing. *Staminodes* 0. *Styles* (1.5–) 1.9–2.6 mm long. *Capsule* ellipsoid or ovoid, (2.5–) 2.9–3.7 mm long, (1.4–) 1.6–2 mm wide, equal to up to twice as long as sepals; *valves* straight or spreading, apex only straight or slightly recurved. *Seeds* 4–9, ellipsoid or suborbicular, 0.9–1.2 mm long, red to dark ruby red, tubercles semi-inflated ridges. **Fig. 1C, 2K–P.** Flowering: Sep.–May.

Distribution and habitat. The taxon occurs in New South Wales from Rules Point on the Murrumbidgee

River, south to Lake Eucumbene, Hume Weir then west along the entire length of the Murray River system and in surrounding drainage areas. In Victoria it occurs in the east around the Goulburn River and coastal areas near Sale and in the west, it is scattered through the Grampians and Dimboola areas. In South Australia it occurs in the Naracoorte to Mount Gambier area and in the Mount Lofty Hills. In Tasmania it occurs on the north and west coasts and is recorded from one locality in the highlands at Oatlands (Fig. 6B).

Locally common in moist areas around swamps, rivers, lakes or dams. Often found growing in muddy or grassy areas after water has receded under open eucalypt woodlands. Found growing in rich damp soils.

Nomenclatural Notes.

Stellaria glauca var. *tenella* Benth. Four sheets from K contain type material. One sheet from the Herbarium Hookerianum has a label '1/20 44 Glenelg river 401' and written on the sheet is 'Victoria Robertson'. Additionally the name 'Stellaria glauca var tenella' is written in what is thought to be Bentham's handwriting. This is a match to the locality in the protologue and the specimens match the description with very small leaves, few small flowers and sepals being rather obtuse. As these specimens are the best match to the protologue, this sheet is here designated as the lectotype.

The second sheet from the Herbarium Hookerianum has a label with '65 Melbourne 17/4/53' and written on the sheet is 'F. Adamson' and again 'var tenella' is written in what is thought to be Bentham's handwriting. The collection matches the locality and specimen details in the protologue but has fewer plants so it has been designated as a residual syntype.

The third sheet has two collections. The collection above the pencil line has a blue label with 'R. Brown, Iter Australiense, 1802–5 No. 5210 Stellaria glauca With. var. tenella Derwent River'. The collection below the pencil line has a blue label with ''R. Brown, Iter Australiense, 1802–5 No. 5210 Stellaria glauca With. var. tenella Kent's Group Bass Straits'. The top collection matches Bentham's locality data but the bottom collection has Kent's Group rather than Kitt's Group as in the protologue. Additionally, the specimens do not match the description, as the sepals are acute rather than blunt. The collections are both *S. multiflora* and there is no indication that this sheet belonged to Herbarium Hookerianum, so the top collection is considered here to be excluded syntype material.

The fourth sheet is from the Herbarium Hookerianum and has the following labels: '652 St Patricks Rv 16/11/44 V. D Land Gunn;' and '652 Collected on Granite rocks at St Patricks River at an elevation of about 2000 feet'. Again while the locality information matches the protologue, the specimens of this collection do not match the description with the sepals being acute rather than obtuse. The specimens are all *S. multiflora* and so these are considered here to be excluded syntype material.

One sheet from BM contains type material. It has a blue label with 'R. Brown Iter Australiense 1802–5 No. 5210 Genus Caryophyll prop Polycarpiem & Alsenem Derwent V D Land 1804'. This collection matches the collection on the top half of the third Kew sheet. The specimens of this collection are *S. multiflora* and do not match the description, and so are considered here to be excluded syntype material.

Arenaria axillaris Luehm. ex Ewart. From examination of the isotype in NSW this taxon belongs to *S. angustifolia* subsp. *tenella*. At present the specimen from MEL has not been seen. This specimen is referred to being in the Melbourne Herbarium by Ewart in 1906. A search of MEL needs to be undertaken to ensure it still exists.

Selected specimens (of c. 105 seen)

New South Wales: Barmah adjacent to Murray River upstream from Echuca, 22 Feb. 1979, *E.A. Chesterfield s.n.* (NSW); Hume Weir, Albury District, 29 Dec. 1965, *R.J. Flynn s.n.* (NSW); Southern Tablelands, Kosciuszko National Park, southern end of Tantangara Reservoir, 26 Jan. 2007, *R.W. Purdie 6325* (CANB); Lake Victoria, Far SW of NSW, June 1945, *Tolley s.n.* (AD).

Victoria: Kulkyne Forest, Far NE corner, Chalka Creek, 24 km (15m) NE of Hattah PO, 14 Oct. 1972, *A.C. Beauglehole 40570* (MEL); Wallpolla Island, 26 Oct. 1972, *A.C. Beauglehole 40649* (MEL); Barmah Regional Park Grid l52: Murray Valley Study Area, 1 Jan. 1985, *A.C. Beauglehole 83536* (MEL); Corangamite Study area, between Lake Terangpom and Lake Gnarpurt, 26 km WSW of Cressy PO, 24 km NE of Camperdown, 15 Oct. 1977, *G.J. Hirth s.n.* (MEL); Nyah State Forest about 4 km N of Nyah, 6 Feb. 1977, *N. Macfarlane 985* (MEL); Cairn Curran Reservoir, near Pyrenees Highway Bridge, Grid J9, North Central Study Area, 11 Jan. 1983, *E.E. Perkins s.n.* (MEL); Lake Hume, just east of old Tallangatta, 0.5 km east of Tallangatta Vallet turnoff on Murray Valley Highway, 22 Jan. 1981, *N.H. Scarlett 81-22* (MEL); Wangaratta to Milawa road, c. 9–10 km SE of Wangaratta. Oxley Flats, 8 May 1980, *I. Tankard s.n.* (MEL).

Tasmania: Oatlands, 4 Jan. 1913, *R.A. Black s.n.* (MEL); Pennerowne Point, 26 Jan. 1984, *A.M. Buchanan 2822* (HO); Mouth of Lagoon River, Jan. 1954, *W.D. Jackson 318* (HO).

South Australia: Near Eden Valley, 13 Jan. 1990, *R.J. Bates 21927* (AD); Southern Lofty, Upper M[ount] Bold Reservoir, 21 Mar. 1993, *R.J. Bates 31800* (AD, CANB); Hundred of Robertson, ca 10 km S of Naracoorte, 24 Sep. 1962, *D. Hunt 1423* (AD); Cox Scrub, 16 Feb. 1990, *D.E. Murfet 908* (AD); Shores of Millbrook Reservoir, 11 Mar. 1962, *D.E. Symon 2072* (AD, BRI, CANB, NE).

1c. *Stellaria angustifolia* subsp. *rotundisepala* C.H.Mill. & J.G.West, *subsp. nov.*

A subsp. angustifolia *et subsp.* tenella *(Benth.) C.H.Mill. & J.G.West sepalis rotundatis vel late ellipticis, apice obtuso et plicato cucullato formenti; seminibus tuberculiis angustis rotundatis prominentibus, distinguenda.*

Holotypus: New South Wales, At Source of Murray R[iver], 6 Jan. 1992, *R.J. Bates* 27162 (AD 99206284). **Isotypi**: CANB, NSW, MEL, NY.

Stellaria angustifolia subsp. *Timbarra River (N.A.Wakefield 4853)* C.H.Mill. in Austral. Pl. Name Index database (APNI), http://www.anbg.gov.au/cgi-bin/apni [accessed

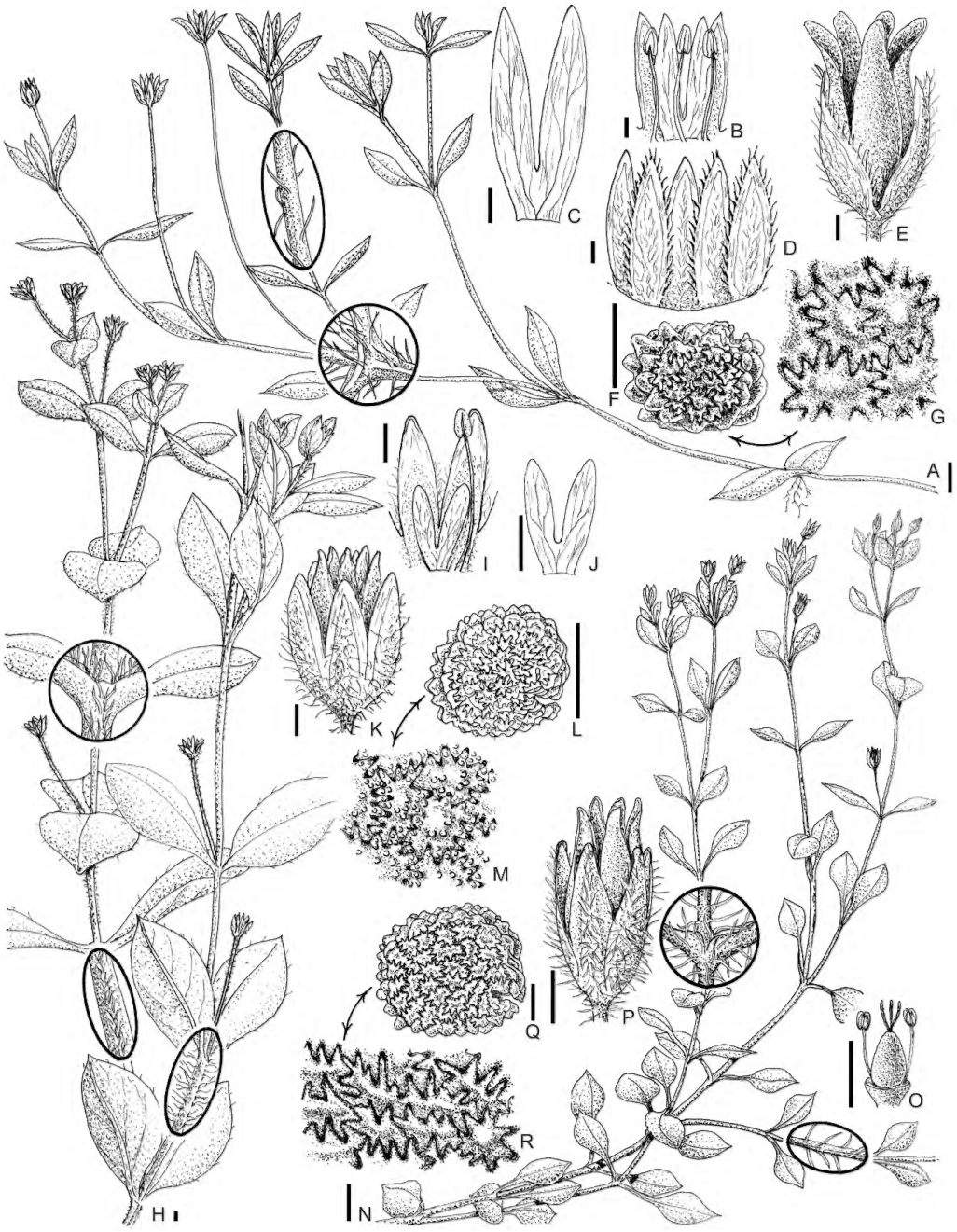

Fig. 3. A–G *Stellaria flaccida*: **A** habit; **B** part of flower showing sepal, petal and stamen arrangement; **C** outer view of sepals; **D** petal; **E** capsule showing position in relation to sepals; **F** seed, side view; **G** seed coat cell detail. **H–M *S. media***: **H** habit; **I** part of flower showing sepal, petal and stamen arrangement; **J** petal; **K** flower showing capsule; **L** seed, side view; **M** seed coat cell detail. **N–R *S. pallida***: **N** habit; **O** part of flower showing ovary, stamens and style arrangement; **P** flower showing sepals and mature capsule; **Q** seed, side view; **R** seed coat cell detail. Scale bars: habits (**A**, **H**,

6 May 2010] & Austral. Pl. Cens. database (APC), http://www.anbg.gov.au/cgi-bin/apc [accessed 6 May 2010].

Annual, slender, erect, usually single stemmed, (6–) 11–25 cm long, glabrous. *Stem and inflorescence leaves* a continuous series, sessile, obovate or linear or ovate or narrower, (3.5–) 6–9.5 (–13) mm long, 0.9–1.8 mm wide, acute to subacute, rarely obtuse. *Inflorescence* axillary and solitary or an interrupted monochasium of 2–3 flowers. *Pedicels* (22–) 27–40 mm long, slender, erect in fruit. *Sepals* round to broad-elliptic, 1.5–2.1 mm long, obtuse, apex folded over to form a hood, sometimes with hood thickened. *Petals* 2.4–3 mm long, longer than sepals, bifid. *Stamens* 10. *Staminodes* 0. *Styles* 0.8–1.5 mm long. *Capsule* ellipsoid to ovoid, (2.9–) 3.4–4.6 mm long, (1.8–) 2.4–3.1 mm wide, from 2 to 4 times longer than sepals; *valves* straight, apex straight. *Seeds* 2–5 (–7), suborbicular, 0.9–1.4 mm long, mid brown to reddish brown to purplish, tubercles very narrow rounded projections totally covering the seed, giving a spiny appearance. **Fig. 1B, 2Q–W.** Flowering: Jan.

Distribution and habitat. This taxon is restricted to high altitudes around the source of the Murray and Tuross Rivers in Kosciuszko National Park in New South Wales and Timbarra River in East Gippsland, Victoria (Fig. 6C).

Found in alpine areas in wet bogs with mixed herbfields.

Notes. Subsp. *rotundisepala* is distinguishable from the other subspecies by its distinct seed and floral characters. Currently only three specimens are known and further collecting is needed in the areas where it occurs to obtain more information about it.

Etymology. Subsp. *rotundisepala* has been named to reflect the unique shape of the sepals which is not found in any other species in Australia; from the Latin *rotundus* for round and *sepalum* for a sepal.

Specimens examined

New South Wales: S. Tablelands, Dillundoo Valley, 11 Jan. 1970, *J.H. Willis s.n.* (MEL, NSW).

Victoria: East Gippsland, Timbarra River, 13 Jan. 1959, *N.A. Wakefield 4853* (MEL).

2. *Stellaria filiformis* (Benth.) Mattf.

Repert. Spec. Nov. Regni Veg. Beih. 100: 148, tab. VII (1938). — *Drymaria filiformis* Benth., Fl. Austral. 1: 162 (1863). — **Type Citation**: "W. Australia, *Drummond, n. 694.*" **Lectotype (here designated):** Swan River *Drummond n. 694* (K, Herb. Hooker p.p,. 2 plants on right hand side of sheet). **Isolectotypes:** (K, Herb. Hooker; MEL 723012).

Euthales (?) *filiformis* de Vriese, Pl. Preiss. 1(3): 414 (1845). — **Type citation:** "In solo sublimoso fertili prope praedium rusticum Dom. Marell, York, d. 30m. Martii 1840. Herb. Preiss. No. 1889." **Holotype:** L (Herb. Lugd. Bat. sh. 909.62-546), n.v, fide J.H. Kern, Blumea 13(1): 116 (1965).

Illustration. C.H.Mill. & J.G.West in N.G.Walsh & Entwisle, Fl. Victoria 3: 236, Fig. 45n–o (1996).

Annual with erect to spreading stems to 15 (–22) cm long, glabrous. *Leaves* forming a basal rosette, sessile, filiform, (4–) 7–20 (–26.5) mm long, (0.2–) 0.4–1.2) mm wide, subacute, herbaceous to fleshy; *inflorescence leaves* sessile, linear to ovate to lanceolate, (0.7–) 1–6.4 (–13) mm long, (0.25–) 0.4–1.1 mm wide, acute, scarious or sometimes herbaceous. *Inflorescence* a dichasium. *Pedicels* 2–11 (–16) mm long, wiry, erect in fruit. *Sepals* 2–4 mm long, acute to obtuse. *Petals* (0.5–) 1–1.5 (–2) mm long, shorter than half sepal length, deeply bifid. *Stamens* (2–) 3–5. *Staminodes* 0–5. *Styles* 0.2–0.6 mm long. *Capsule* narrow, ovoid to ellipsoid, (2–) 2.5–4.5 (–5.5) mm long, 1–1.5 mm wide, equal to twice sepal length; *valves* straight, rarely spreading, apex straight. *Seeds* 5–13, suborbicular, 0.5–0.75 mm long, cream, light to mid brown, smooth, with minute conical tubercles. **Fig. 1D, 4A–H.** Flowering: (June–) Aug.–Nov.

Distribution and habitat. This taxon has a disjunct distribution across southern Australia. There are isolated records in the Wyalong district in New South Wales. In Victoria it is confined to the north-west region around Wyperfeld National Park, south to the Grampians area and then westwards across to the south-east of South Australia as well as the Eyre Peninsula. In Western Australia it occurs from the Fraser Range in the east, Lake King, Cowcowing and west across to the Irwin River (Fig. 6D).

Locally common in mallee scrub, eucalypt woodlands and heathlands often in sandy soils and well drained shallow sandy loams, sometimes in the swales between dunes.

Common Name. Thread starwort.

Notes. Stellaria filiformis is distinct as it is the only species in Australia with a basal rosette of filiform leaves and it lacks prominently tuberculate seeds. Instead the seeds are smooth with minute conical tubercles, usually with pits in the top (Fig. 1D) and while the cell shape is similar to those of the subspecies of *S. multiflora*, the seeds are much smaller than those of the subspecies of *S. multiflora*.

Stellaria filiformis shows affinities with *S. multiflora* as they share similar habitats and reduced petals and stamens. The collections made in New South Wales are all from the 1920s. It is unusual that there are no other known collections, as the habitat in which the taxon occurs in other states is found in the central west to south west of New South Wales.

Nomenclatural Notes.

Drymaria filiformis Benth. Two sheets from Herbarium Hookerianum held at K contain type material. One sheet has two collections on it. The collection on

N) 5 mm; flowers & fruits 1 mm; ovary (**O**) & seeds (**F**, **I**, **P**) 0.5 mm. — **A–G** *B. Copley 5175* (AD 97810081); **H–J** *C.R. Alcock 605* (AD 966220095); **N–R** *C.R. Alcock 10738a* (AD 99021068).

the left hand side (LHS) of the pencil line has the label 'West Australian Goldfields Spencer Moore 1895' and is not considered part of the type collection. The collection on the right hand side (RHS) of the pencil line has '694 Swan river Drummond' written on the sheet and matches the protologue and has thus been designated here as the lectotype. Also written in pencil on the sheet is a description of *Drymaria filiformis* which is thought to be in Bentham's handwriting.

A second K sheet has the label 'Swan R[iver]. Drummond No 694 Pres? By W.W. Sanders, Esq. FLS'. This sheet matches the other type material and thus has been designated here as an isolectotype.

One sheet from MEL, (MEL 723012) has the label 'W.A. J Dr' with a tag with the number 694 located on the specimen. As the collecting information and the specimen match the type material this has also been designated here as an isolectotype.

Euthales (?) *filiformis* de Vriese. This is a legitimate taxon, as Kern (1965) discusses. It is the oldest name available for the species but, as the epithet *filiformis* is already occupied in the genus *Stellaria*, it cannot be transferred to that genus, and as such is unavailable for use.

Selected specimens (of c. 70 seen)

New South Wales: Pine Ridge, Wyalong, Nov. 1920, *A. Cooper s.n.* (BRI, CANB, NSW); Central W. Slopes, Upper slope of Wamboyne Mountain, W of Lake Cowal, Dec. 1993, *A.N. Rodd & A. Clements 9245* (NSW).

Victoria: Wyperfeld National Park, junction of track with Dattuck Track, ca 3 mls ENE of Eastern Lookout, 1 Oct. 1968, *A.C. Beauglehole 28770* (CANB, MEL); Sunset Country, E to W track, c. 35 km S of Meringur, 23 Sep. 1981, *J.H. Browne 52* (MEL, NSW); Wandown Fauna Reserve, 10 miles ENE of Annuello, 5 Sep. 1970, *N. Macfarlane 537* (MEL).

South Australia: Northern Flinders Ranges; Baratta Hill, 11 Sep. 1986, *R.J. Bates 7164* (AD); Eyre Peninsula; Gawler Ranges, 24 Sep. 1989, *R.J. Bates 21078* (AD); Gammon Ranges ca. 65 km E of Leigh Creek, Near mouth of gorge of Arcoona Creek S of Arcoona Bluff Range, 17 Sep. 1956, *Hj. Eichler 12685* (AD); Murray; Lowan Conservation Park, 1 Oct. 1981, *A.G. Spooner 7895* (AD).

Western Australia: Goldfield Ranges survey, Flat north of range, c. 9km NE of Bungalbin Hill, 28 Sep. 1995, *M. Gibson & M. Lyons 3356 p.p.* (CANB); Cowcowing, Aug. 1904, *M. Koch 1122* (HO, PERTH); Central South, Eyre Hwy ca 23 miles (37km) E of Fraser Range, 6 Sep. 1963, *J.H. Willis s.n.* (MEL); 23 km S of Lake Grace township, 8 Sep. 1967, *P.G. Wilson 6225* (PERTH); 26 km W of Warriedar HS, 26 Sep. 1986, *P.G. Wilson* 12267a (PERTH).

3. *Stellaria flaccida* Hook.

Companion Bot. Mag. 1(9): 275 (1836). — *S. media* var. *flaccida* (Hook.) Hook.f., Bot. Antarct. Voy. III. (Fl. Tasman.) 1: 43 (1855). — **Type Citation:** 'Mr. Gunn (n. 450.)'. **Lectotype (here designated):** Common near Launceston amongst rocks where shaded, *Gunn 450* (K, Herb. Hooker p.p. [LHS of the pencil line], Kew Loan Number 0589-86-5). **Isolectotype:** 450 very common in dense shady thickets growing under logs, etc., [*Gunn*] (K, Herb. Hooker p.p. [LHS of the pencil line], Kew Loan Number 0589-86-7).

Stellaria flaccida β Hook., J. Bot. (Hooker) 2: 411 (1840), nom. inval.

Illustration. C.H.Mill. & J.G.West in N.G.Walsh & Entwisle, Fl. Victoria 3: 236, Fig. 45j–k (1996).

Perennial, stems lax to 50 cm long, which may root at nodes, with creeping rhizome, almost glabrous to sparsely hairy. *Stem and inflorescence leaves* a continuous series, subsessile to appearing petiolate; narrow ovate, elliptic, broad ovate or obovate, (5–) 7–20 (–23) mm long, (1–) 2–10 (–17) mm wide, acute, margin entire or undulate with hairs few to almost ciliate, flaccid. *Inflorescence* axillary and solitary to a monochasium of up to 6 (–10) flowers. *Pedicels* (13–) 20–73 (–80) mm long, erect to pendant in fruit. *Sepals* 3.5–6.5 (–7.5) mm long, margins glabrous to ciliate. *Petals* (3.7–) 4–7.5 (–8.2) mm long, equal to or longer than sepals, deeply bifid. *Stamens* 10. *Staminodes* 0. *Styles* 2.2–3.7 mm long. *Capsule* usually ovoid, 5.2–7.7 mm long, (2.9–) 3.4–5 (–5.5) mm wide, equal to twice sepal length; *valves* spreading, rarely straight, apex recurved or twisted sideways, rarely straight. *Seeds* 4–14, suborbicular to obloid, 1.3–2.2 (–2.6) mm long, light grey-brown to almost black, tubercles rounded to shortly ridged, inflated. **Fig. 1H, 3A–G.** Flowering: Sep.–Mar.

Distribution and habitat. This taxon occurs on the tablelands and coastal plains of south-eastern Australia from southern Queensland to Tasmania, excluding the Bass Strait Islands. It also occurs westward from the Otway Ranges, and Dandenongs in Victoria as well as in the Southern Lofty Ranges and on Kangaroo Island in South Australia (Fig. 6E).

The species grows in damp sites associated with rivers and creeks in fern communities, rainforests, and wet sclerophyll to tall open eucalypt forests, often with grassy understorey; often found in disturbed areas such as along roadsides and tracks. It occurs on a range of soil types from sands to silts and clays and on granite, basalt, limestone and sandstone.

Notes. The indumentum of the sepal margins varies considerably with the most common state consisting of two sepals with glabrous margins, one sepal with one margin ciliate and one margin glabrous, and two sepals with both margins ciliate. The degree of hairiness of the margins varies from almost glabrous with a few hairs on the base of the margins to densely ciliate along the entire margin; almost every state between the two has been observed. This pattern of distribution of the hairs is also found in the introduced taxon *S. graminea*. Specimens on the edges of the distribution range, particularly in Queensland and South Australia, tend toward *S. angustifolia* in being more glabrous and having leaves closer to linear.

Nomenclatural Notes.

Stellaria flaccida Hook. Two sheets from Herbarium Hookerianum held at K contain type material. The

first sheet has two collections, the first on the LHS of the pencil line has a label with '[Gunn] 450 Stellaria flaccid Common near Launceston, amongst rocks where shaded' and hand written on the sheet is 'No. 450. Mr. Gunn Van D's Land St. flaccida Hook' in what is thought to be Hooker's handwriting. As this information and the specimen match the protologue it is here designated as the lectotype. On the RHS of the sheet is another collection from Kiama NSW and it is not type material.

The second sheet has two collections on it. The first label attached to the specimen on the LHS of the pencil line, has '450 Stellaria flaccida Hook Very common in dense shady thickets growing under logs, etc' on it. This information matches the protologue and thus is here designated as the isolectotype. The second label has '450/1842 V D Land Gunn Circular Head 4/11/37' written on it, which post-dates publication and is thus not considered to be type material. This collection also has a handwritten note in Hooker's hand; 'Stellaria flaccida β 450 Gunn V D land'. This name was invalidly published by Hooker (1840).

Selected specimens (of c. 235 seen)

Queensland: Mount Merino, Beereenbano Lookout, 2 Dec. 1970, *I.R. Telford 2625* (BRI, CANB).

New South Wales: 12 miles S of Nowedoc, Pigeon Top and track, 7 Nov. 1972, *J. Carrick 3287* (AD); SE Coast, Mt Dromedary near central Tilba, which is ca 190 km N of Vic border, 26 Apr. 1973, *R.J. Chinnock 266* (AD); NT, Eastern side of current Barrington trail c. 100 m S of TO to Little Murray camping area, Barrington Tops National Park, 9 Apr. 2003, *J.R. Hosking & B.J. Neilly 2301* (CANB).

Victoria: On track to summit of Mt Ellery, between Big River Track and summit, 22 Feb. 1984, *D.E. Albrecht & B.J. Conn 211* (BRI, MEL); Near Delegate [Mount], 8 Jan. 1992, *R.J. Bates 27246* (AD); D26 Grampians, Victoria Range, Victoria Range Track (W of Sawmill Track), on top of range, 14 Jan. 1969, *A.C. Beauglehole 30262* (MEL); Gippsland region, Wilson's Promontory National Park. Along road from carpark to Mt Oberon, 6 Dec. 1975, *Hj. Eichler 21793* (CANB).

Tasmania: Four Mile Stream, 6 km S of Falmouth, 23 Nov. 1974, *R.J. Chinnock 2180* (AD); Ferntree, Mt Wellington, 1 Jan. 1972, *J.H. Hemsley 6658* (HO, NSW); Midlands, Kubla Khan Cave State Reserve ca 10 km W of Mole Creek township, 16 May 1983, *A. Moscal 2392* (HO); Central Highlands, East slope of Archers Sugarloaf, Feb. 1986, *A. Moscal 12501* (HO); Ben Lomond Tower Hill, East Tower, Feb. 1980, *M.G. Noble 29078* (HO).

South Australia: Kangaroo Island, Ravine des Casoars, s.dat., *R.J. Bates 30356* (AD, CANB); Ravine des Casoars, s.dat., *R.J. Bates 30425* (AD, CANB); Waterfall Gully, near Adelaide, 16 Nov. 1887, *J.H. Maiden s.n.* (NSW).

4. * *Stellaria graminea* L.

Sp. Pl. 1*:* 422 (1753). — **Type Citation:** 'Habitat in siccis juniperetis sepibus Europea'. **Lectotype:** Herb. Burser XI: 111 (UPS n.v.; LINN 584, photo), fide Jonsell & Jarvis in Nordic J. Bot. 14: 159 (1994).

Illustration. C.H.Mill. & J.G.West in N.G.Walsh & Entwisle, Fl. Victoria 3: 236, Fig. 45g (1996).

Perennial, usually erect single or several stemmed to 60 (–89) cm long, sometimes with short vegetative side shoots, with a slender rhizome and frequently rooting at nodes, glabrous except for hairs on margins of leaves and some sepals. *Stem leaves* sessile, narrow ovate, linear or obovate, (7.3–) 10–30 (–35) mm long, (1.6–) 2–5 (–5.3) mm wide, acute to subacute, herbaceous; *inflorescence leaves* sessile, ovate to broadly ovate, triangular, (1.8–) 2.5–6 (–9.2) mm long, (0.6–) 1–2 (–2.6) mm wide, scarious, rarely green. *Inflorescence* usually a dichasium. *Pedicels* (9–) 15–50 (–75) mm long, slender, erect in fruit, usually ridged. *Sepals* (2.3–) 3–6 (–6.7) mm long, margins glabrous to ciliate, acute. *Petals* (1.5–) 2.2–5.2 (–5.9) mm long, shorter than to longer than sepals, very deeply bifid. *Stamens* 10, often innermost whorl of 5 reduced but functional. *Staminodes* 0. *Styles* (1–) 1.5–3.5 (–4) mm long. *Capsule* ovoid to ellipsoid, 3.3–4.8 mm long, 1.8–2.8 mm wide, equal to or longer than sepals; *valves* straight, apex straight or sometimes upper margin recurved. *Seeds* 6–10 (–26), suborbicular to ellipsoid, (0.5–) 0.8–1.2 mm long, reddish brown to ruby red, tubercles narrow ridges, semi-inflated. **Fig. 1E, 5A–G.** Flowering: Nov.–Feb.

Distribution and habitat. This species has been collected only a few times from five localised areas in Australia. It appears to have been introduced into Tasmania first in the early 1900s at Tyenna and Junee River. The last collection on the main island was at Junee River in 1942. One specimen has been collected from King Island in 1979. In Victoria it has only been collected once from the Cann River in 1946. In New South Wales several collections dating from 1951 until 2007 have been made in the Kosciuszko region. In South Australia one specimen has been collected from Parawa in 1984 (Fig. 6F). The native range is thought to be most of Europe but the species has also spread and is now found throughout Europe and North America and is considered to be a weed (Chater & Heywood 1993).

This is a rare weed that is found in very damp areas on the edges of rivers, swamps, lakes in grassland or *Leptospermum* scrub. It grows in soils that retain moisture such as black mud or granites.

Notes. Stellaria graminea can be distinguished from the endemic *S. angustifolia* by its dichasial inflorescence that has differentiated floral leaves and by its distinct pattern of hairs on the sepal margins. This pattern of hairs is also found in the Australian species *S. flaccida.* This character is also useful to distinguish *S. graminea* from the European species *S. palustris*. *S. graminea* can be distinguished from *S. flaccida* by its dichasial inflorescence that has dimorphic floral leaves.

Specimens seen

New South Wales: S. Tablelands, [Kosciuskzo], Diggers Ck, 25 Jan. 1951, *L.A.S. Johnson & E.F. Constable s.n.* (NSW); Southern Tablelands, Kosciuszko National Park, on track from Charlottes Pass to Blue Lake on right hand side in drainage line on last hillside before, 22 Feb. 2007, *J. McAuliffe et al. 732* (CANB); S. Tablelands, [Kosciuskzo], White River area, 24 Jan. 1967, *T.Y Stead s.n.* (NSW); S. Tablelands, [Kosciuskzo], Diggers Ck Lake, National Park, 2 Feb. 1978, *J. Thompson 2777* (NSW).

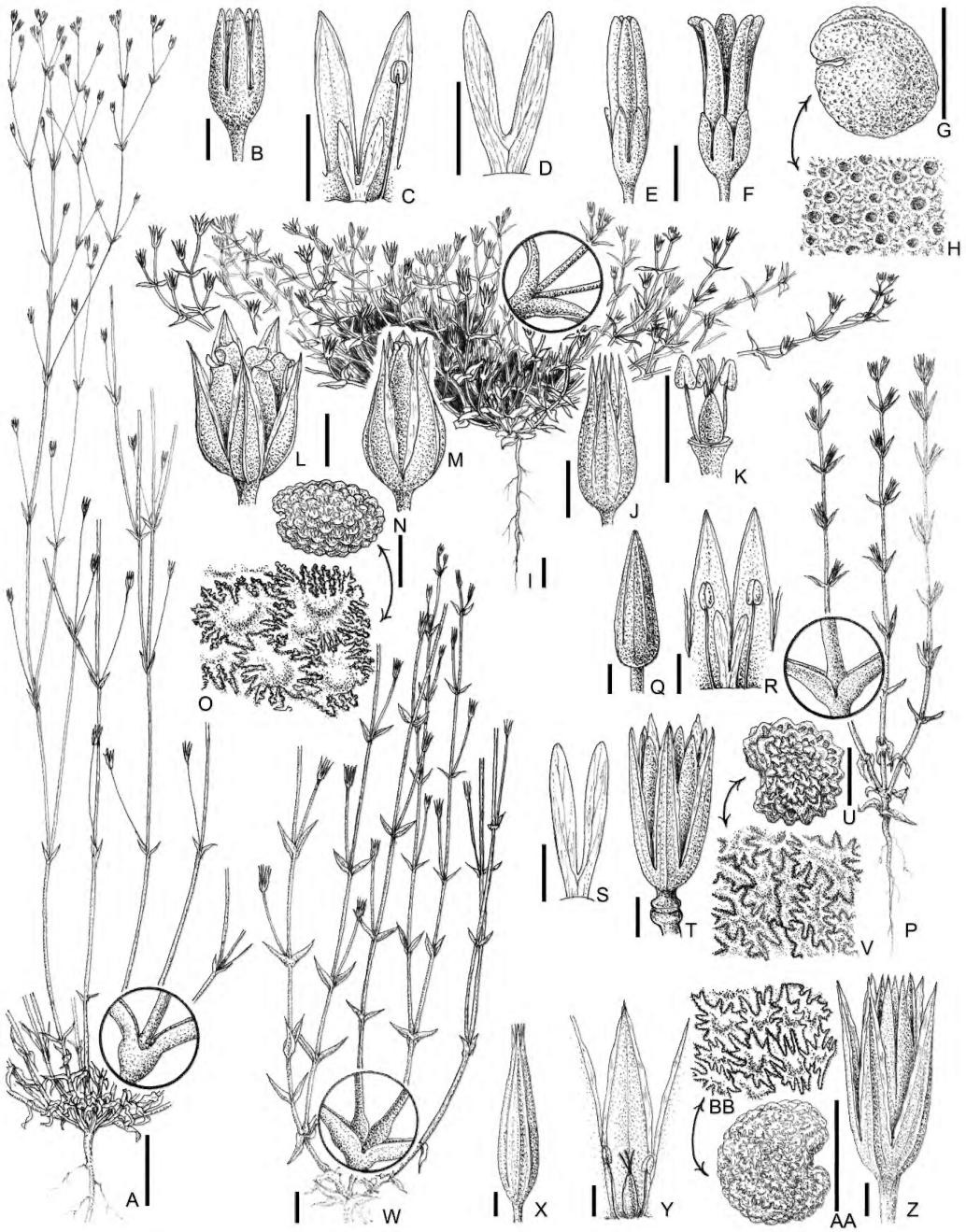

Fig. 4. A–H *Stellaria filiformis*: **A** habit; **B** flower; **C** part of flower showing sepal, petal and stamen arrangement; **D** petal; **E** flower showing mature capsule; **F** flower with opened capsule; **G** seed, side view; **H** seed coat cell detail. **I–O *S. multiflora*** subsp. ***multiflora***: **I** habit; **J** flower; **K** part of flower showing ovary, stamen and style arrangement; **L** flower showing mature capsule; **M** flower with immature capsule; **N** seed, side view; **O** seed coat cell detail. **P–V *S. multiflora*** subsp. ***collaris***: **P** habit; **Q** flower; **R** part of flower showing sepal, petal and stamen arrangement;

Victoria: East Gippsland, Cann River Grid Z31, 1946, *N.A. Wakefield 3691* (MEL).

Tasmania: Junee River, 19 Dec. 1942, *H. & J. Gordon s.n.* (HO); Waratah, Dec. 1924, *A.H.S. Lucas s.n.* (NSW); King Island, Sea Elephant River, 9 Jan. 1979, *D.I. Morris 7964* (HO); East Coast Tyenna, Nov. 1903, *L. Rodway s.n.* (HO).

South Australia: 2 km W of Parawa, 28 Jan. 1984, *R.J. Bates 3652* (AD).

5. *Stellaria leptoclada* (Benth.) C.H.Mill. & J.G.West, *comb. nov.*

Stellaria glauca var. (?) *leptoclada* Benth., Fl. Austral. 1: 158 (1836). — **Type citation:** "New England, *C. Stuart*". **Holotype:** New England, *C. Stuart* (K, Herb. Hooker).

Stellaria sp. *leptoclada (B.G.Briggs 2194)* C.H.Mill. In: Austral. Pl. Name Index database (APNI), http://www.anbg.gov.au/cgi-bin/apni [accessed 6 May 2010] & Austral. Pl. Cens. database (APC), http://www.anbg.gov.au/cgi-bin/apc [accessed 6 May 2010].

Annual, fine, small, weak to erect, single or several stemmed to 20 (–30) cm long, sometimes arising from (loose) basal rosette, glabrous, scabrous or with hairs sparsely scattered on stems. *Stem and inflorescence leaves* a continuous series, often attenuate, appearing petiolate; narrowly obovate, linear to narrowly ovate, (2–) 3–17 (–20) mm long, (0.6–) 0.8–2 (–3.4) mm wide, acute to subacute, entire, margin scabrous, toothed or with short hairs on lower parts, rarely scabrous on midrib. *Inflorescence* a monochasium. *Pedicels* (9–) 14–34 (–45) mm long, slender, erect, often reflexed in fruit, glabrous or slightly scabrous. *Sepals* (3–) 3.5–5.2 (–5.6) mm long, acute to acuminate. *Petals* (3–) 3.4–5 mm long, shorter than to slightly longer than sepals; deeply bifid. *Stamens* 10. *Staminodes* 0. *Styles* (1–) 1.5–2.2 mm long. *Capsule* narrowly ovoid to ellipsoid, rarely broader, 3.2–4.8 (–5.5) mm long, 1.5–2.4 mm wide, usually equal to slightly longer than sepals, rarely shorter than sepals, *valves* spreading or straight, apex straight or recurved. *Seeds* (5–) 10–14 (–22), suborbicular, rarely broadly reniform, (0.55–) 0.6–0.85 (–1.1) mm long, light to mid or reddish-brown, tubercles narrow ridges, semi-inflated. **Fig. 1F, 2X–DD.** Flowering: Aug.–Jan.

Distribution and habitat. There is a single specimen known from south-east Queensland in the Silverwood area. The remaining specimens have been collected from New South Wales mostly from the Great Dividing Range from Boggabri in the north to Gloucester in the south (Fig. 6G).

Scattered to locally common in moist sites in undisturbed grassland under open woodlands or forests. It grows on granites or soils derived from granite, or rarely on serpentine or basaltic soils.

Notes. S. leptoclada is a relatively rare herb that has frequently been overlooked. *S. leptoclada* can be distinguished from *S. angustifolia* using habit, leaf shape, indumentum and floral characters. It differs from *S. graminea* in its habit, leaf shape and lack of differentiated floral leaves. It also has a much more restricted geographic distribution. See also notes under *S. angustifolia*.

Selected specimens (of c. 40 seen)

Queensland: Silverwood, Sep. 1922, *C.T. White 1713* (BRI).

New South Wales: Near Cobar, Sep. 1910, *L. Abrahams s.n.* (NSW); Watchimbark Creek, NW of Gloucester, 21 Sep. 1968, *D.F. Blaxell & R.G. Coveny 6* (NSW); Graman, Jan. 1959, *T.V. Bourke s.n.* (NSW); Coulson's Creek, foot of Liverpool Range, N of Merriwa, 28 Sep. 1968, *B.G. Briggs 2194* (NSW); Warialda, Aug. 1933, *F. Browne s.n.* (NSW); North Western Slopes, Warrabah National Park, semi-cleared area, 2.5 km E of camping area, 5 Oct. 2001, *L.M. Copeland 3198* (CANB); NW Slopes, Ashford Road via Bonshaw Road, 17 Oct. 1993, *R.G. Coveny & A.J. Whalen 16649* (CANB); Attunga State Forest, 27 Sep. 1985, *J.R. Hosking 323* (CANB, NE); North-west Slopes, eastern side of Woodsreef mine, 27 Aug. 1992, *J.R. Hosking 516* (CANB, MEL, NE); [Dumaresq] dam, above walking track, 18 Oct. 1990, *S. McIntyre s.n.* (NSW); Wallangra, 28 Sep. 1929, *Ex Herb Rodway 603* (NSW); Glenn Innes, Mar. 1913, *H. Wenholz s.n.* (NSW).

6. * *Stellaria media* (L.) Vill.

Hist. Pl. Dauphiné (Villars) 3(1): 615. (1789). — *Alsine media* L., Sp. Pl. 1: 272 (1753). — **Type citation:** 'Habitat in Europea cultis'. **Lectotype:** Herb. Linn. No. 388.1 (LINN, Photo), fide Turrill in Turrill & Milne-Redhead, Fl. Trop. E. Africa, Caryophyllaceae: 24 (1956); image also available at http://www.nhm.ac.uk/jdsml/research-curation/research/projects/linnaean-typification

Stellaria media (L.) Cirillo, Essent. Pl. Char. Comment. 36 (1784), nom. inval.

Illustration. C.H.Mill. & J.G.West in N.G.Walsh & Entwisle, Fl. Victoria 3: 236, Fig. 45a–b (1996).

Annual, semi-erect to erect herb to 40 (–56) cm long with long straggly branches, may root from nodes, with single line of hairs down internodes and pedicels and hairs on the back of sepals and leaf margins. *Stem and inflorescence leaves* a continuous series, the lower leaves are often petiolate, narrowed, very attenuate,1–15 (–18) mm long, upper part broad ovate to ovate to elliptic, rarely linear, (3.5–) 6–18 (–24.5) mm long, (1–) 2–10 (–14) mm wide, acute, often undulate. *Inflorescence* a condensed, leafy dichasium. *Pedicels* (2.1–) 4–16 (–22) mm long, erect in fruit. *Sepals* 3–5.5 (–6) mm long, obtuse, often forming small hood, often with purple mark, outer sepal backs sparsely to densely hairy, frequently glandular, rarely glabrous. *Petals* (1.6–) 2.5–3.6 mm long, half to almost sepal length, deeply bifid. *Stamens* 3–5. *Staminodes* 0, rarely 1–3. *Styles* 0.5–0.8 (–1) mm long. *Capsule* ovoid to ellipsoid, (3–) 4–6 (–6.5) mm long, 2.2– 3.5 (–3.8) mm wide, just

S petal; **T** flower showing mature capsule and thickened collar on pedicel; **U** seed, side view; **V** seed coat cell detail. **W–BB *S. multiflora*** subsp. ***nebulosa***: **W** habit; **X** flower; **Y** part of flower showing sepals, ovary, stamen and style arrangement; **Z** flower showing mature capsule; **AA** seed, side view; **BB** seed coat cell detail. Scale bars: habits (**A**, **I**, **P**, **W**) 5 mm; flowers & fruits 1 mm; petals (**D**, **S**), ovary (**K**) & seeds (**G**, **N**, **U**, **AA**) 0.5 mm. — **A–H** *R.J. Chinnock 7348* (CANB 00523485); **I–N** *R.J. Bates 30390* (AD 99328276); **O–U** *Hj. Eichler 12833* (AD 95727048); **V–AA** *R.J. Bates 25994* (AD 99146306).

shorter than to longer than sepals; *valves* spreading, apex recurved or straight. *Seeds* (5–) 7–15, discoid to flattened-ellipsoid, (0.8–) 0.9–1.2 (–1.4) mm long, red to black to dark purplish-brown, tubercles rounded hills, semi-inflated, cell walls with minute papillae. **Fig. 1G, 3H–M.** Flowering: all year, but predominantly July–Dec.

Distribution and habitat. Occurs in the North from Bundaberg, Queensland along the east coast and Great Dividing Range through New South Wales to the Victorian coast and mountains, along the Murray floodplain and west to South Australia from Adelaide and surrounding ranges as far west as Port Lincoln. Also occurs in eastern Tasmania and the Bass Strait Islands. There are a few records for the Northern Territory from Alice Springs and in Western Australia from coastal areas from Albany to just north of Perth. Also a single specimen is known from Kununurra in northern Western Australia. There are also scattered occurences outside these areas in gardens (Fig. 6H). The native range is thought to be throughout Europe except in the extreme north (Chater & Heywood 1993), but it is currently found on every continent, absent only from the polar regions and very dry areas. It is an important economic weed of crops.

Stellaria media is a common introduced weed, especially in areas of disturbance such as roadsides, waterways and areas of cultivation. Usually found in shady or moist places in coastal dunes, grass or herbfields, gully forests, open forests, heathlands, scrubs or swamps. Grows on most substrates from rocky soils to sands.

Common name. Chickweed, Common Chickweed.

Notes. *S. media* is frequently confused with *S. pallida*. From close examination of Australian material and limited overseas material it has become apparent that there are problems in the delimitation of these two taxa. The main character that distinguishes them is the presence or absence of petals. In the Australian specimens of *S. pallida* petals are always absent, and the character state of reduced or minute petals does not occur. However, non-Australian literature indicates that this is not always the case overseas (Clapham et al. 1952; Morton 1972; Rabeler 1988; Chater & Heywood 1993; Morton 2005).

In Australian specimens of *S. media* the petals are always present and easily visible. In occasional specimens the petals may be very short but they are always bifid. However, there are several other characters where there is a slight overlap between the two taxa. The most useful character to distinguish the two species is the number of stamens. *S. media* usually has 3 – 5 stamens present or very rarely only two. *S. pallida* has 2 stamens or very rarely 3 or 4. Seed colour and size can also be useful. In less than 10% of *S. pallida* specimens seeds measure more than 0.8 mm in diameter. *S. pallida* has either pale seeds only or a mixture of dark and light seeds in one capsule. The seeds in *S. media* are usually 1 mm or larger in diameter, rarely less. The colour of *S. media* seed is brown to black or occasionally medium brown but they are never pale when mature. *S. pallida* has shorter stigmas (0.5 mm or shorter) and these tend to be spreading and reflexed. By contrast, *S. media* has longer stigmas (0.5 mm or longer) and these are mostly erect with only the apex revolute.

Characters traditionally used in keys to separate these taxa such as sepal length, the presence of glandular hairs on backs of sepals and the attachment of the upper leaves show too much variation and overlap to be useful.

In non-Australian literature these two taxa have usually been treated separately, particularly in recent years (Chater & Heywood 1993; Chen & Rabeler 2001; Morton 2005). This is also the case in the Australian literature (Curtis 1975; Chorney 1986; Doust 1990; Miller & West 1996). Chromosome numbers also support this separation with *S. media* having 2n=40, 42, 44 and *S. pallida* having 2n=22 (Chen & Rabeler 2001; Morton 2005).

Nomenclatural Notes. In some Australian literature the authorship of *S. media* has been given as "(L.) Cirillo". However Cirillo (1784) did not validly publish the combination, as he did not definitely associate the generic name and the specific epithet.

Selected specimens (of c. 295 seen)

Queensland: Leslie Dam, 10km W of Warwick, 3 Oct. 2000, *G.N. Batianoff & C. Appelman 2010375* (CANB); Athol Hall, near Westbrook, about 11 km SW of Toowoomba, 05 Sep. 1947, *S.L. Everist 3156* (BRI); Jolly's Falls, c. 2.5km WNW of the Summit railway siding, 12 Sep. 2003, *B.L. Lepschi et al. 4955* (CANB); In grounds of CSIRO Long Pocket Laboratories, Indooroopilly, Brisbane, 19 July 1973, *V.K. Moriarity 1330* (CANB).

New South Wales: S. Tablelands, Bendethera Caves, 20 miles [32 km] c. W of Moruya, 10 May 1966, *E.F. Constable 6863* (NSW); Murrumbidgee River, in Euroley State Forest (1 km N of entrance), 20 Sep. 1992, *C.H. Miller & J. Palmer 590* (CANB); Broken Hill, 24 Oct. 1927, *A. Morris s.n.* (AD); North Coast Clouds Creek, via South Grafton, 1 Nov. 1949, *H.M. Provisional School 31* (NSW); C. Tablelands, Coxs R, 6 miles [9.6 km] W of Little Hartley, 30 Aug. 1970, *J. Thompson 628* (NSW).

Australian Capital Territory: S. Tablelands, Turner, Canberra, 5 Sep. 1964, *H.S. McKee 11590* (NSW)

Victoria: Gippsland region, Raymond Island, SW corner, 14 km SE of Bairnsdale, 27 Sep. 1992, *I. Crawford 1885* (CANB, MEL, NSW); Just inside entrance of Johnson Swamp Game Reserve, 4.6 km off Kerang to Leitchville Road, 24 Sep. 1992, *C.H. Miller & J. Palmer 601* (CANB); Port Phillip Bay, Mud Island, Oct. 1983, *J. Yogovic s.n.* (MEL).

Tasmania: King Island, Councillor Island, east coast of King Island, 8 July 1966, *W. Bartlett s.n.* (HO); Central Highlands, Wild Dog Tier, Mar. 1984, *A. Moscal 6787* (HO); Mt. Field, beside Sitzmark Lodge, Mt. Field National Park, 6 Jan. 1978, *J.M.B. Smith 320* (HO); Lenah Valley, 2 Aug. 1963, *P.A. Tyler s.n.* (HO); East Coast East of Bicheno township, on seaward side, Jan. 1983, *J.G. West 4833* (HO); Furneaux Group, Mount Chappell Island, 12 Aug. 1973, *J.S. Whinray 1141* (MEL); Kents group, Deal Island, Lighthouse Gully, 29 Nov. 1970, *J.S. Whinray 1251* (CANB).

Northern Territory: AZRI [Arid Zone Research Institute, Alice Springs], 18 Oct. 1985, *P.K. Latz 10260* (DNA); Alice Springs, 19 Sep. 1977, *A.S. Mitchell 419* (AD, DNA).

South Australia: Southern Eyre Peninsula, 12 Ellen St, Port Lincoln, 19 Aug. 1965, *C.R. Alcock 605* (AD, NSW); Southern Lofty, Onkaparinga Gorge, Oct. 1991, *R.J. Bates 25970* (AD, CANB); South-eastern, 71 Crouch St, Mt Gambier, 11 Oct. 1969, *B. Copley 2826* (AD, NSW); Koonamore Station, ca. 400 km NNE of Adelaide, near Bindyi, Mustering Pdk no. 3, 7 Sep. 1973, *M.D. Crisp 547* (CANB); Nixon-Skinner Conservation Park, Hundred of Myponga, Section 245, 25 Sep. 1974, *T.M. Heddle & R.B. Heddle WSK27* (AD); Bool Lagoon, ca 25 km S of Naracoorte, 18 Sep. 1961, *D. Hunt 436* (AD); Northern Flinders Range, Leigh Creek township, (ca 280 km NNE of Pt Augusta), East Park, 27 Sep. 1971, *T.R.N. Lothian 5162* (AD); Southern Flinders Range, Mambray Creek (Mt Remarkable National Park), ca 40 km SSE of Port Augusta, Lower Alligator Creek area, 7 July 1974, *D.J.E Whibley 4379* (AD).

Western Australia: Lake William, West Cape Howe, 30 km W of Albany, 10 Sep. 1987, *G.J. Keighery & J.J. Alford 1819* (PERTH); Oria Orchards, Packsaddle Plain, 8.3 km from Kununurra PO bearing 218 degrees, 2 Aug. 2002, *A.S. Mitchell 7341* (CANB); Pig Saleyard, Mt Barker, 1 Sep. 1979, *G. Perry 948* (PERTH).

7. *Stellaria multiflora* Hook.

Companion Bot. Mag. 1: 275 (1836). — **Type Citation:** '*Mr. Gunn* (*n. 451*)'. **Lectotype (here designated):** V D's Land, *Mr Gunn No. 451* [maybe written in Hookers hand] (K, herb. Hooker p.p., two plants in centre of sheet inside pencil line box).

Stellaria sp. Cooyar (*A.R.Bean 10622*) Qld Herbarium, Austral. Pl. Name Index database (APNI), http://www.anbg.gov.au/cgi-bin/apni [accessed 6 May 2010] & Austral. Pl. Cens. database (APC), http://www.anbg.gov.au/cgi-bin/apc [accessed 6 May 2010].

Stellaria glauca var. *tenella* auct. non Benth.: Benth., Fl. Austral. 1:158 (1863), p.p., only with respect to Robert Brown's and Gunn's Tasmanian collections.

Annual with slender taproot, sometimes rooting at nodes; glabrous or with sparse hairs on stems and leaf margins; stems prostrate and mat-forming or spreading to erect, to 25 (–45) cm long. *Stem and inflorescence leaves* in a continuous series, sessile to appearing petiolate; obovate to elliptic to ovate to lanceolate or linear, (1.5–) 2.5–11 (–17.5) mm long, (0.3–) 0.7–2.5 (–3.5) mm wide, acute to obtuse, glabrous or with hairs sparse on lower half of margin. *Inflorescence* of (2–) 3–15 (–27) flowers, interrupted monchasium to a well-developed monochasium. *Pedicels* 0.5–20 (–26) mm long, erect in fruit, quadrangular, smooth, collar beneath fruit present or absent. *Sepals* 2–5.5 (–6) mm long, acute to acuminate, straight or bent. *Petals* 0 or 2–5, rarely 6, (0.2–) 0.4–1 (–1.2) mm long, shorter than half sepal length, shortly bifid or entire. *Stamens* (2–) 3–10. *Staminodes* 0–5. *Styles* 0.2–0.8 mm long. *Capsule* narrow to broad, ovoid to ellipsoid, (2–) 2.5–5.5 (–6) mm long, 1–2.5 (–3.5) mm wide, from 0.75 to 1.5 times sepal length; *valves* spreading or straight, apex straight, recurved to revolute in upper half. *Seeds* (3–) 5–21 (–25), suborbicular to broadly ellipsoid to reniform, 0.5–1 (–1.3) mm long, yellow, light to mid brown, sometimes reddish, tubercles rounded to narrow ridges, often inflated. Flowering (Jul.–) Aug.–Dec. (–Feb.).

Distribution. A widespread endemic species in temperate Australia, from south-eastern Queensland, eastern New South Wales, Victoria, southern South Australia, south-western Western Australia, Tasmania and the Bass Strait Islands.

Notes. S. multiflora is a taxon of considerable variability and requires further study. We have decided to recognise some of the more obvious variation at subspecies level as there is sufficient evidence to warrant this but more work needs to be done.

The members of the *S. multiflora* can be distinguished by the reduction of the floral structures, particularly the petals and stamens. These characters are variable, which is problematic for the identification of these taxa. However by using a combination of characters, or indeed a shared lack of characters, the following taxa can be determined. It is interesting that one of the key characters for delimiting the genus *Stellaria*, the presence of bifid petals is not always observed in this complex. The petals when present are usually minute, less than 1 mm long and can be reduced to fragments. The stamens are also reduced, usually less than 1 mm long and staminodes are also sometimes present.

The specimen *A.R. Bean 10622* (*Stellaria sp. Cooyar*) has been examined and belongs to *S. multiflora*. The specimen is very immature and the floral characters place the specimen in either subsp. *multiflora* or subsp. *nebulosa*. Mature fruit is required to place it definitively.

Nomenclatural Notes.

Stellaria multiflora Hook. One sheet from Herbarium Hookerianum held at K contains type material. The first label attached to the top LHS of the sheet with one plant is '451/1842 Launceston 15/10/41'. As the collecting date post-dates publication, it is not considered to be type material. The second label in the middle of the sheet, defined by a pencil line, has two plants with the following written on the sheet; 'No. 451 Stell. multiflora Hook. V. Ds L and Mr Gunn Petals 0'. Gunn 451 matches the protologue and thus is here designated as the lectotype. The third label at the bottom of the sheet associated with several plants has ' 1077 V. D[iemens] Land JDH[ooker]' written on it and as this does not match the protologue, it is not considered to be type material.

Key to subspecies of *S. multiflora*

1. Mature fruit broadly ellipsoid, usually > 2 mm wide; valve apex strongly revolute. . . . . **a.** subsp. ***multiflora***

1: Mature fruit narrowly ovoid to narrowly ellipsoid, < 2 mm wide; valve apex straight or slightly recurved, never revolute

2. Fruiting pedicels with distinct collar, pedicel at collar > 0.5 mm wide; petals 3–5 (–6), minute but usually bifid. . . . . **b.** subsp. ***collaris***

2: Fruiting pedicels lacking collar, pedicel c. 0.5 mm wide or less; petals absent. . . . . **c.** subsp. ***nebulosa***

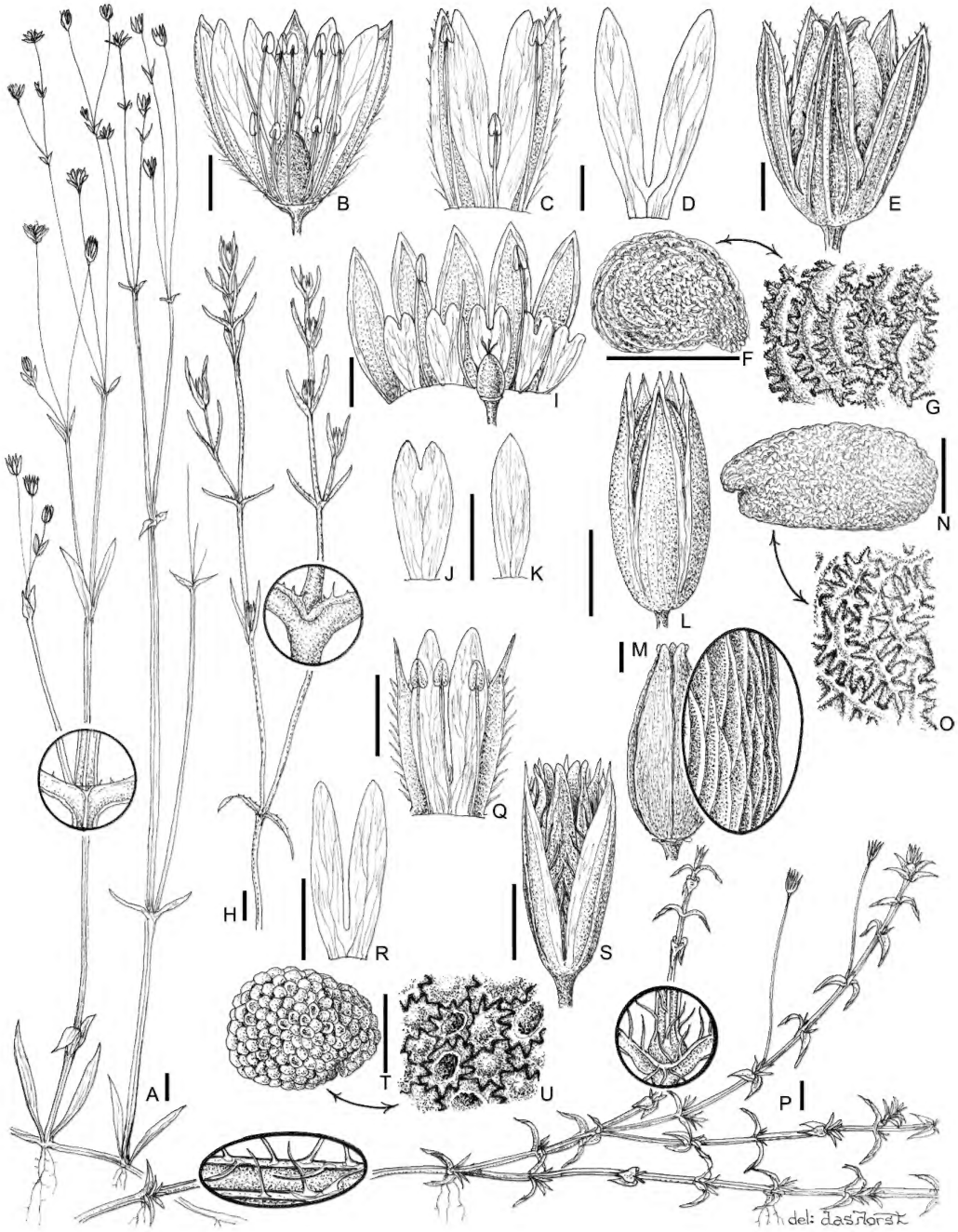

Fig. 5. A–G *Stellaria graminea*: **A** habit; **B** cross section of flower showing sepal, petal and stamen arrangement; **C** part of flower showing detail of sepal, petal and stamen; **D** petal; **E** capsule showing position in relation to sepals; **F** seed, side view; **G** seed coat cell detail. **H–O *S. papillata***: **H** habit; **I** part of flower showing sepal, petal and stamen arrangement; **J-K** petal; **L** flower showing capsule; **M** mature capsule showing detail of surface papillae; **N** seed, side view; **O** seed coat cell detail. **P–U *S. pungens***: **P** habit; **Q** part of flower showing sepals, petals and stamen arrangement; **R** petal;

7a. *Stellaria multiflora* Hook. subsp. *multiflora*

Illustration. C.H.Mill. & J.G.West in N.G.Walsh & Entwisle, Fl. Victoria 3: 236, Fig. 45r–t (1996).

Annual, often mat-forming or erect to 16 (–36) cm long, sometimes rooting at nodes, glabrous. *Stem and inflorescence leaves* in a continuous series, sessile to appearing petiolate; obovate, elliptic, ovate or linear, (3–) 4–9.8 (–11.5) mm long, (0.6–) 1–2.5 (–3.5) mm wide, acute to subacute. *Inflorescence* a monochasium. *Pedicels* 0.5–10 (–20) mm long, collar absent. *Sepals* (2–) 2.5–4.5 (–5) mm long. *Petals* 0, sometimes 2–4, (0.2–) 0.5–0.8 (–1) mm long, shortly bifid or reduced to a single arm. *Stamens* 5–10. *Staminodes* usually 0, sometimes 1–4. *Styles* 0.3–0.6 mm long. *Capsule* broad ellipsoid, (2–) 2.5–5 (–5.5) mm long, (1.5–) 2–3 (–3.5) mm wide, 0.75 to 1.25 times sepal length; *valves* straight or spreading, apex strongly revolute. *Seeds* (5–) 7–21, suborbicular to broadly ellipsoid, 0.5–1 (–1.3) mm long, yellowish, light to mid to reddish brown, tubercles rounded ridges, inflated. **Fig. 1L, 4I–O.** Flowering: Aug.–Nov.

Distribution and habitat. Subsp. *multiflora* is widespread but uncommon. There is one record from south-eastern Queensland from the Bunya Mountains collected in 1919, but the majority of collections are found in south-eastern Australia from the southern tablelands and alpine areas of New South Wales, eastern Victoria and central to eastern Tasmania. There are a few scattered collections in south-central and south-western Victoria. It also occurs in the Mt Lofty Ranges and on Kangaroo Island in southern South Australia. There are also a few collections from south-west Western Australia, one collected in 1867 from Porongurup, one collected in 1986 from Hamersley Inlet and a couple of early collections by J. Drummond with a locality of Swan River (Fig. 6I).

It grows in various habitats from damp eucalypt forests to woodlands and grasslands, alpine to subalpine areas or rarely found in coastal situations. Grows in rocky sites or shallow soils overlying granite or dolerite.

Selected specimens (of c. 110 seen)

Queensland: Bunya [Mountains] RAOU Exn, Oct. 1919, *C.T. White s.n.* (BRI).

New South Wales: South Coast, 2 km N of Nungatta (47 km SW of Eden), 14 Oct. 1974, *R.G. Coveny & J. Armstrong 5777* (NSW); Southern Tablelands, 'Royalla' S boundary, E of Jerrabomberra Creek, 3.1 km ENE of Lobb Hill, 11 Dec. 1998, *I. Crawford 5074* (CANB); Tumbarumba, The Glen, 7 Nov. 1949, *E.J. McBarron 3956* (NSW); S. Tablelands, Myanba Gorge Lookout, 25 km E of Bombala, Coolangubura National Park, 10 Sep. 1998, *J. Miles s.n.* (NSW); Creek W of the Perisher, 8 Apr. 1979, *J. Thompson 3091* (NSW); 1 mile E of Gaerlock Homestead, Countegany area, 4 Aug. 1969, *T. & J. Whaite 3251A* (NSW).

Australian Capital Territory: Mt. Gingera, Cotter River District, 29 Nov. 1966, *L.G. Adams 1644* (CANB, NSW); Upper Cotter Valley, 24 Feb. 1959, *N.T. Burbidge 6361* (CANB); Kowen area near NSW/ACT border, 30 Sep. 1959, *N.T. Burbidge & M. Gray 6549* (CANB); Western base of Black Mountain, 5 Sep. 1964, *H.S. McKee 11587* (CANB, NSW).

Victoria: Melbourne study area, Brisbane Ranges National Park, W of Nelson Lookout, 1.5 km E of Switchback Road, 3 km N of Anakie, 1 Oct. 1977, *A.C. Beauglehole & E.G. Errey 56717* (MEL); Glenmaggie Regional Park, Gippsland Lakes Hinterland Study area, 21 Oct. 1984, *A.C. Beauglehole 78670* (MEL); Snowfileds, Snowy Range, beside headwaters of Shaws Creek, 2 km NNE from the Gorge; 5 km NNW from Mt Arbuckle, 2 Apr. 1994, *N.G. Walsh 3638* (MEL).

Tasmania: South West Hibbs Bay, 27 Jan. 1984, *A.M. Buchanan 2840* (HO); East Coast, Broad River near Cluny Lagoon, 8 Oct. 1989, *P. Collier 4270* (HO); North East Wedgetail Peak, 22 Oct. 1983, *A. Moscal 3769* (HO); Central Highlands Little Split Rock, 8 Mar. 1984, *A. Moscal 6738* (HO).

South Australia: Southern Lofty, Upper Hermitage, *R.J. Bates 29684* (AD); Kangaroo Island, Ravine des Casoars, 21 Dec. 1992, *R.J. Bates 30423* (AD, CANB); Rivoli Bay, 1888, *F. Mueller s.n.* (MEL); SE Wirrega, ca 25 km NW of Bordertown, ca 32 km SE of Keith, 2 Oct. 1916, *R. Tate s.n.* (AD); Blanchetown (ca. 115 km NE of Adelaide), s.dat., *R. Tate s.n.* (AD 97602434).

Western Australia: Hamersley Inlet, 3.6 km WNW of Edwards Point (IRNP), 28 Sep. 1986, *K. Newbey 11162* (PERTH); Porongurup Range, Castle Arch, Sep. 1958, *G.G. Smith s.n.* (PERTH).

7b. *Stellaria multiflora* subsp. *collaris* C.H.Mill. & J.G.West *subsp. nov.*

A subsp. multiflora *et subsp.* nebulosa *pedicelo collo juxtim fructu, distinguenda; quoque a subsp.* multiflora *fructu maturo angusto–ovoideo < 2 mm lato, et valva apice recto nunquam revoluto, differt; et a subsp.* nebulosa *petalis semper praesentibus differt.*

Holotypus: Australian Capital Territory: Western slope of Black Mountain, 11 Oct. 1964 *H.S. McKee 11668* (CANB 145524). **Isotypi:** CANB 319264, NSW.

Stellaria aff. *filiformis*, N.Burb. & M.Gray, Fl. Austral. Capital Terr. 166 (1970).

Stellaria sp. D sensu Doust in G.J.Harden, Fl. N.S.W. 1: 276 (1990).

Stellaria sp. 1 sensu C.H.Mill. & J.G.West in N.G.Walsh & Entwisle, Fl.Victoria 3: 238, Fig. 45p-q (1996).

Stellaria sp. 1 Flora of Victoria (*H.S.McKee 11668*) C.H.Mill., Austral. Pl. Cens. database (APC), http://www.anbg.gov.au/cgi-bin/apc [accessed 6 May 2010].

Glabrous herb with erect to spreading stems, to 20 (–23) cm long. *Stem and inflorescence leaves* in a continuous series, sessile to appearing petiolate; obovate, linear or lanceolate, (2–) 3–11 (–13.5) mm long, 0.5–2 (–2.5) mm wide, acute to subacute. *Inflorescence* a monochasium of (2–) 5–15 (–27) flowers. *Pedicels* to 8 (–10) mm long, rarely longer with distinctive collar-like thickening present in fruit. *Sepals* 3–5.5 (–6) mm long. *Petals* 3–5 (–6), (0.2–) 0.4–1 (–1.2) mm long, usually bifid. *Stamens* (2–) 3–5. *Staminodes* 0. *Styles* 0.2–0.6 mm long. *Capsule* narrow ovoid, (2.5–) 3.5–5.5 (–6) mm long, 1–1.5 (–1.8) mm wide, 1 to 1.5 times sepal length; *valves* spreading, rarely straight, apex straight,

S flower showing sepals and mature capsule; **T** seed, side view; **U** seed coat cell detail. Scale bars: habits (**A**, **H**, **P**) 5 mm; flowers & fruits 1 mm; seeds (**G**, **O**, **U**) 0.5 mm. — **A–G** *R.J. Bates 3652* (AD 98421323); **H–O** *J. McKean 5189* (CANB 327583); **P–U** *R.J. Bates 3571* (AD 98433224).

never revolute. *Seeds* (9–) 12–20 (–25), reniform to suborbicular, 0.5–0.7 (–0.8) mm long, light to reddish-brown, tubercles narrow rounded ridges, semi-inflated. **Fig. 1M, 4P–V.** Flowering: (June–) Aug.–Oct. (–Dec.)

Distribution and habitat. Subsp. *collaris* occurs in south-eastern Queensland, with a sporadic inland distribution from Chinchilla and Warwick. It also occurs on the slopes and plains of northern New South Wales from Cobar in the west to Breeza in the east and Temora in the south, with one collection from Black Mountain in the Australian Capital Territory. In Victoria it is found in the central districts from Bendigo west to Wyperfeld National Park. It occurs in South Australia, just across the border in Chowilla, north to Wilpena and the Gammon Ranges (Fig. 6J).
Locally common in understorey of eucalypt open forest and woodlands, *Callitris* woodlands or mallee shrublands. Grows on sandy to loam soils.

Notes. Subsp. *collaris* tends to be a larger, more robust plant than the other subspecies of *S. multiflora*. It is found at medium altitudes on the slopes of ranges or further west on the plains. It does not appear to grow in more extreme habitats such as alpine or coastal areas where the other subspecies of *S. multiflora* are found. This taxon has a disjunct distribution and more collecting is needed to determine the full extent of its range.

Etymology. The name is derived from the Latin *collare* which means collared, in reference to the collar-like structure that is present on the top of the pedicel, just under the mature fruit. This character is not found in any other *Stellaria* occuring in Australia.

Selected specimens (of c. 30 seen)

Queensland: Near Warwick, Jun. 1892, *F.M. Bailey s.n.* (NSW); Charleys Creek near Chinchilla, Sep. 1978, *G. Lithgow 21* (BRI).

New South Wales: Breeza, Between Gunnedah & Werris Creek, Oct. 1899, *W. Court s.n.* (NSW); Western plains, 40 km NNW of Cobar, Bundella Station, Elura mining lease, Emu Tank, 8 Sep. 1978, *M.D. Crisp 4209* (CANB); Temora, Oct. 1915, *Rev. J.W. Dwyer s.n.* (CANB); SW, Munagai Stn, 26 Jul. 1968, *T. Henshall 1062* (DNA); Trangie, Sep. 1968, *T. Hunter s.n.* (NSW); SW Plains, Monaro Vale, Sep. 1983, *D.E. Jones 1498* (NSW).

Victoria: Wyperfeld National Park, N of Black Flat, 19 Sep. 1968, *A.C. Beauglehole 28268* (MEL); Wimmera Study Area, Ellam Flora reserve, 18 Sep. 1986, *A.C. Beauglehole 84702* (MEL); 143rd Meridian Rd. 2–3 miles S of Murray Valley Highway SE of Robinvale, 4 Aug. 1973, *N. Macfarlane 636* (MEL).

South Australia: Chowilla Survey 1988, On road to Hypurna (still on Chowilla Station), 5 Aug. 1988, *R.J. Bates 14866* (AD); Lochness Well Gammon Range National Park, far Northern Flinders Range, 15 Oct. 1993, *R.J. Bates 34268* (CANB); Northern Flinders Range, Gammon Ranges (ca 65 km E of Leigh Creek = Telford), Ridge N of North Tusk (ca 12 km E of Owieandana Hut), 19 Sep. 1956, *Hj. Eichler 12819* (AD); Wilpena hill slope opposite chalet, 16 Sep. 1960, *D.E. Symon 656* (AD, BRI).

7c. *Stellaria multiflora* subsp. *nebulosa* C.H.Mill. & J.G.West *subsp. nov.*

A subsp. multiflora *fructu maturo anguste ovoideo vel anguste ellipsoideo minus quam 2 mm lato, et valva apice recto nunquam revoluto, distinguenda; et a subsp.* collaris *C.H.Mill. & J.G.West pedicelo collo juxtim fructu absente, et petalis absentibus, differt.*
Holotypus: South Australia: Region 13 South-eastern: Marshes Swamp, 14 Oct. 1991 *R.J. Bates 25994* (CANB 470161). **Isotypus:** AD 99146306.

Herb, glabrous or occasionally with sparse hairs. Stems prostrate to erect, to 16 (–23) cm long. *Stem and inflorescence leaves* in a continuous series, sessile to appearing petiolate; obovate, linear, elliptic or occasionally narrowly ovate, (1.5–) 2.5–11 (–17.5) mm long, (0.3–) 0.7–2 (–3) mm wide, acute to subacute, glabrous or with hairs on lower half of margin. *Inflorescence* a monochasium of 2–15 (–25) flowers. *Pedicels* (1.5–) 2–20 (–26) mm long, sometimes quadrangular, collar absent. *Sepals* 2–5.5 (–6) mm long. *Petals* 0. *Stamens* 3–10. *Staminodes* 0–5. *Styles* 0.3–0.8 mm long. *Capsule* narrow, ovoid to ellipsoid, (1.9–) 3–5.4 (–6.1) mm long, 1–2 mm wide, equal to 1.3 times sepal length; *valves* spreading or straight, apex straight, sometimes slightly recurved. *Seeds* (3–) 5–17 (–21), suborbicular, sometimes ellipsoid, (0.5–) 0.7–1 (–1.2) mm long, yellowish, light to mid-brown or rarely reddish-brown, tubercles broad hills, semi-inflated. **Fig. 1N, 4W–BB.** Flowering: (Jul.–) Aug.–Dec. (–Feb.).

Distribution and habitat. This taxon occurs at Yetman on the northern slopes of New South Wales, in coastal areas of Victoria, from the Gippsland area to Wilson's Promontory and from the eastern Bass Strait islands to north-eastern Tasmania. It is also found in south-western areas of Victoria around Dimboola, and south-eastern South Australia around the Mount Gambier area as well as on Kangaroo Island (Fig. 6K).

Common to locally abundant in a wide range of habitats including *Eucalyptus baxteri* coastal dune scrub, heathlands, low alpine herbfields and open eucalypt forests, often in damp areas on sandy to rocky soils.

Notes. Currently, subsp. *nebulosa* consists of those individuals of *S. multiflora* that lack the characters of the other two subspecies and does not have any unique defining characters such as the revolute capsule valves of subsp. *multiflora* and the thickened collar-like structure on the fruiting pedicel of subsp. *collaris*. It is found in a diverse range of habitats and locations. There seems to be three groups within the distribution: one is a southern band from the north of Tasmania across the Bass Strait Islands with an outlier on the central Victorian coast; the second is centred around Dimboola in western Victoria across to eastern South Australia in the Mount Gambier region with an outlier on Kangaroo Island; and the third is from the central west of New South Wales north possibly into central Queensland. This taxon is poorly represented, particularly in the north and often these

specimens do not contain fully mature fruit to allow for a definitive identification.

Etymology. This subspecies has been named from the Latin *nebulosus* which means 'clouded, cloudy, misty or foggy' which reflects the definition of this taxon which is currently those individuals that remain after other elements of the species have been defined.

Selected specimens (of c. 45 seen)

New South Wales: Mt Jagungal, Kosciuszko region, s.dat., *D.N. McVean s.n.* (CANB); Nicholls Rd, Bebo State forest, 1.3 km S of Wood Bend (10.2 km N of Yetman), 23 Aug. 1987, *R.G. Coveny et al. 12701* (CANB, NSW).

Victoria: Grampians, Mt. Arapiles, 18 Feb. 1959, *A.C. Beauglehole 5338* (MEL); Nurcoung Flora Reserve. Wimmera Study area, Sector A, subblock 4A, 13 Nov. 1986, *A.C. Beauglehole 86892* (CANB, MEL); East Gippsland: Tildsley Forest Block. 200 m E of walking track from Gibbs Beach along 90 mile Beach. 20 m N in lee of primary dune, Nov. 1992, *A.B. Pollock s.n.* (MEL); South-west, Wilson's Promontory Pillar Point track above mouth of Tidal River, 5 Oct. 1973, *J.H. Willis s.n.* (MEL).

Tasmania: Furneaux, Behind Planter Beach, East Flinders Island, 26 Sep. 1989, *P. Collier 4200* (HO); North East Reeves Creek Picnic Rocks, 13 Sep. 1983, *A. Moscal 2675* (HO); Kents Group; North East Island, South Hill, 29 Sep. 1971, *J.S. Whinray 1150* (CANB); Furneaux Group, Flinders Island. High dunes c. 150 yards E of entrance of East River, s.dat., *J.S. Whinray 8318* (CANB).

South Australia: South eastern, Marshes Swamp, 14 Oct. 1991, *R.J. Bates 25992* (AD, CANB); Kangaroo Island, Ravine des Casoars, 21 Sep. 1992, *R.J. Bates 30244* (AD, CANB); South-eastern, Near Naracoorte South Primary School, c. 95 km N of Mt Gambier, 11 Sep. 1964, *D. Hunt 2132* (NSW); Ca 30 km SE of Mt Gambier, Sep. 1966, *I.B. Wilson 536* (AD, CANB).

8 * *Stellaria pallida* (Dumort.) Crep.

Man. Fl. Belgique, ed. 2, 19 (1866). — *Alsine pallida* Dumort., Fl. Belg. (Dumortier) 109 (1827). — **Type citation:** 'In cultis humidis solo arenoso'. **Type:** BR?, n.v. *S. pallida* (Dumort) Pire, Bull. Soc. Roy. Bot. Belgique *2*: 49 (1863), nom. inval.

Illustration. C.H. Mill. & J.G.West in N.G.Walsh & Entwisle, Fl. Victoria 3: 236, Fig. 45c–d (1996).

Annual, almost prostrate, semi-erect to erect and leafy to 30 (–41) cm long, with a single line of hairs down stem internodes and pedicels. *Stem and inflorescence leaves* a continuous series, sessile to appearing petiolate, lower part narrowed, very attenuate, (0–) 2.5–10 (–16) mm long, upper part broad elliptic to elliptic or ovate, (2.5–) 4–15 (–29) mm long, (0.9–) 1.5–10 (–17) mm wide, acute, entire, often undulate, hairs sparse to almost ciliate on narrowed leaf base margin. *Inflorescence* a leafy dichasium often condensed. *Pedicels* (2–) 3–15 (–18) mm long, erect or reflexed in fruit. *Sepals* (2.2–) 2.5–4 (–5.1) mm long, obtuse, often forming small hood, rarely acute, sometimes with purple mark at apex , hairs on midrib only to densely covering backs, rarely glandular, sometimes glabrous. *Petals* 0. *Stamens* 2, rarely 3 or 4. *Staminodes* 0–2 (–4). *Styles* 0.4–0.5 (–0.6) mm long. *Capsule* ovoid to ellipsoid, (2.3–) 3–4 (4.9) mm long, (1.5–) 1.7–2.2 (–2.5) mm wide, equal to slightly longer than sepals, rarely just shorter than sepals; *valves* spreading, apex only recurved, rarely revolute. *Seeds* (6–) 8–15 (–19), discoid to flattened ellipsoid, (0.55–) 0.6–0.8 (–1) mm long, yellowish to mid-brown, rarely darker, tubercles rounded hills, semi-inflated, cell walls with minute papillae. **Fig. 1I, 3N–R.** Flowering: all year around, but predominantly July–Nov.

Common name. Lesser Chickweed.

Distribution and habitat. Found at scattered localities within New South Wales, along the Great Dividing Range from Tenterfield to Canberra, with one collection inland at Broken Hill. It also occurs along the Murray River drainage system in New South Wales and Victoria. It is found throughout most areas of Victoria except alpine areas as well as throughout coastal and coastal ranges of South Australia including Kangaroo Island; the northern most collections extend into the Flinders Ranges and the western most collection is at Fowlers Bay near Ceduna. This species is uncommon in Tasmania being mainly found on offshore islands and in coastal regions but occasionally further inland. It is also uncommon in Western Australia with coastal collections from Rottnest Island and Busselton in the west, Bremer Bay in the south and Cocklebiddy in the east near the South Australian border (Fig. 6L).

The native range of *S. pallida* extends throughout most of central to western and southern Europe (Chater & Heywood 1993). It has also spread as a weed into the Americas and Asia.

In Australia, *S. pallida* is an introduced weed, often locally common, especially in areas of disturbance such as roadsides, waterways and areas of cultivation. Usually found in shady or moist places. It grows in coastal dunes, grass or herbfields, gully forests, open forests, heathlands or scrubs. It usually grows in sandy soils, sometimes in shallow soils over rock or loam to clay soils.

Notes. See notes under *S. media*. This weed probably has a wider distribution in Australia than listed here but is often overlooked or often misidentified as *S. media*. From examining the herbarium collections it appears *S. pallida* is a relatively recent introduction to Australia. There are very few collections prior to the 1950's with the earliest collection recorded in 1905 at Tallandoon in Victoria.

Selected specimens (of c. 200 seen)

New South Wales: Murrurundi, park on Western side of New England Highway, 12 Oct. 1993, *R.G. Coveny & A.J. Whalen 16555* (CANB); Southern Tablelands, Mirrunga, 8km S of ACT border, Murrumbridgee River at confluence with Gossoon Creek, 12 Oct. 1995, *I. Crawford 3168* (CANB); Central Coast Salesyards, Flemington, 28 Sep. 1968, *E.J. McBarron 15864 bis* (NSW); On road to Zara station, 0.7 km from entrance on edge of Billabong Creek, 21 Sep. 1992, *C.H. Miller & J. Palmer 595* (CANB); NW Plains, Iolanthe, c. 26 km SW of Garah, 28 Sep. 1978, *K.L. Wilson 1913* (NSW).

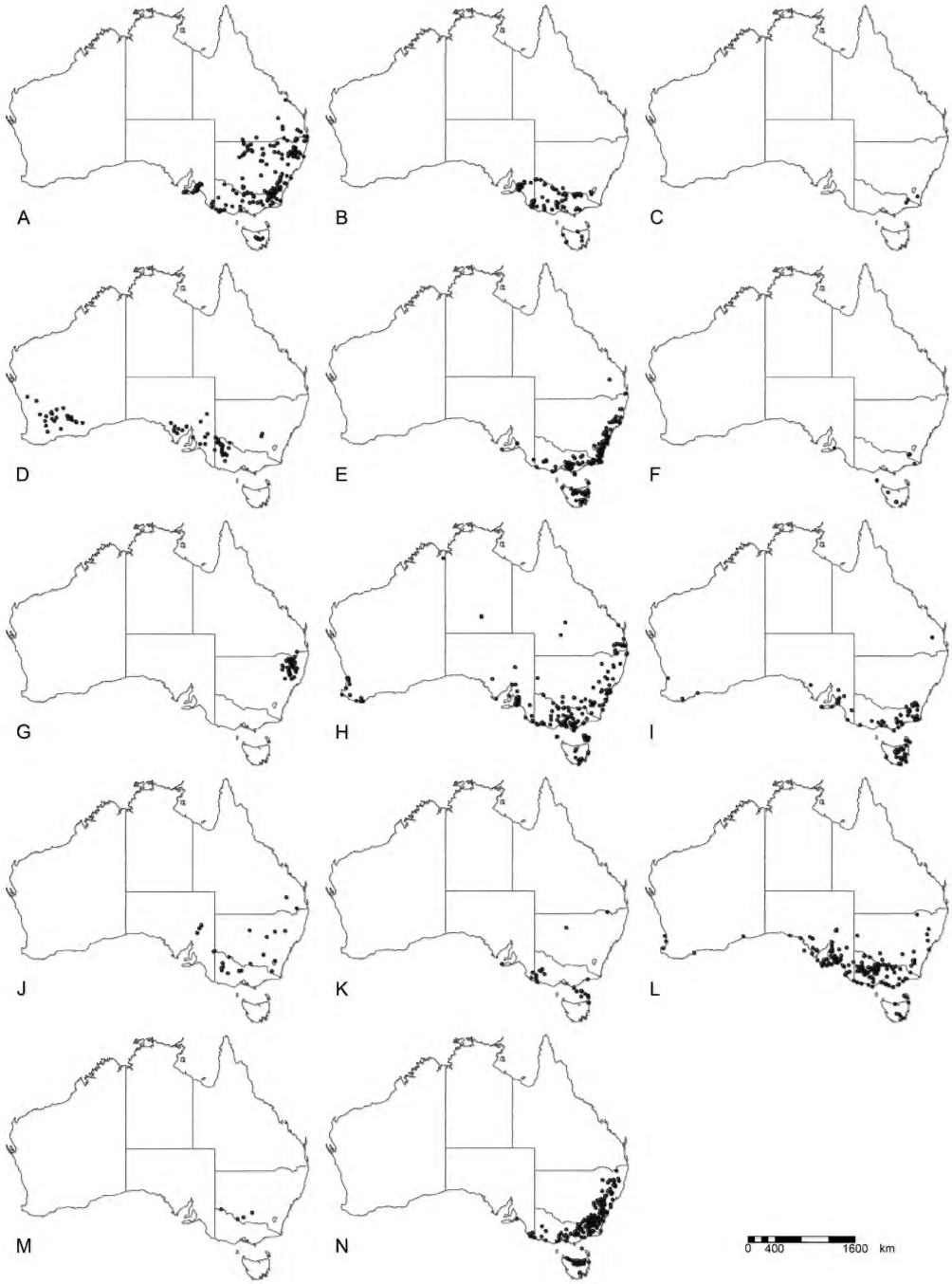

Fig. 6. Distribution maps of *Stellaria* in Australia. **A** *S. angustifolia* subsp. *angustifolia*; **B** *S. angustifolia* subsp. *tenella*; **C** *S. angustifolia* subsp. *rotundisepala*; **D** *S. filiformis*; **E** *S. flaccida*; **F** *S. graminea*; **G** *S. leptoclada*; **H** *S. media*; **I** *S. multiflora* subsp. *multiflora*; **J** *S. multiflora* subsp. *collaris*; **K** *S. multiflora* subsp. *nebulosa*; **L** *S. pallida*; **M** *S. papillata*; **N** *S. pungens*.

Australian Capital Territory: Hill opposite Cotter Pumping Station, Murrumbidgee River, 21 Aug. 1964, *J. Edyvane s.n.* (CANB, NSW).

Victoria: Mt Arapiles, ca 20 miles W of Horsham, the NE portion of the mount near the lookout, 3 Oct. 1963, *H.I.Aston 1064* (MEL); Grampians National Park, 30 Aug. 1983, *A.C. Beauglehole 74484* (MEL); Wilsons Promontory National Park, 15 Dec. 1983, *A.C. Beauglehole 75969* (MEL); Port Campbell National Park, W of Port Campbell, W side of Port Campbell Creek, 5 Sep. 1966, *A.C. Beauglehole & E.W. Finck 21053* (MEL); Ca 1 km inland from the mouth of the Aire River, 5 km SW of Horden river, 28 July 1980, P.*C. Heyligers 80020* (CANB); Thompsons Beach, Murray River at Cobram, 24 Sep. 1992, *C.H. Miller & J. Palmer 603* (CANB); Little Desert Salt Lake, Coynallan Parish, 15 Oct. 1966, *J.H. Willis s.n.* (MEL).

Tasmania: Midlands Port Sorell, 20 Sep. 1986, *P. Collier 1630* (HO); East Coast Betsey Island, 15 Oct. 1983, *K. Harris s.n.* (HO); Furneaux Group, Prime Seal Island, off West coast of Flinders Island, 11 Dec. 1986, *S. Harris s.n.* (HO); North East, Picnic Rocks, 19 Sep. 1983, *A. Moscal 2836* (HO, MEL); Waddles, Hunting Grounds, Jordan river, 20 Aug. 1965, *M. Ridpath WL420* (CANB).

South Australia: Muray Mallee, Reserve at Chauncey's Line S of Monarto South (Ca 60 km SE of Adelaide), 23 Sep. 1959, *Hj. Eichler 16201* (AD); Kangaroo Island, Block 101, Kingscote North, 24 May 1983, *G. Jackson 1590* (AD); Piccaninnie Blue Lake, ca 20 km E of Port MacDonnell (near the border of Vic & SA), 29 Aug. 1964, *T.R.N. Lothian 2935* (AD); Adelaide, Marlowe Rd, Keswick, 09 Sep. 1987, *J. Roberts 289* (CANB); Yorke Peninsula, Port Davenport, 23 Sep. 1978, *D.E. Symon 11072* (AD); 3 km W of Blinman on rd to Parachilna Gorge, 29 Sep. 1985, *J.G. West 5067* (CANB); Fowler's Bay, about 6 km W along roadside, (Fowler's Bay ca 115 km W of Ceduna), 12 Sep. 1960, *D.J.E. Whibley 608* (AD, CANB); Southern Flinders Range, Mambray Creek (Mt Remarkable National Park), ca 40 km SSE of Port Augusta, Lower Alligator Creek area, 7 July 1974, *D.J.E. Whibley 4404* (AD).

Western Australia: Eyre, SW Cocklebiddy, 8 Oct. 1985, *G.J. Keighery & J.J. Alford 434* (PERTH); Rottnest Island, Bickley Swamp, 14 Aug. 1987, *G.J. Keighery 9063* (PERTH); Busselton, 20 July 1987, *G.J. Keighery 9115* (PERTH); Kooljerrenup Nature reserve; 400 m S of Herron Point, 12 Oct. 2005, *G.J. Keighery 16732* (CANB); Gorden Inlet, 15 km NE of Bremer Bay, 17 Sep. 1986, *K. Newbey 11510* (PERTH).

9. *Stellaria papillata* C.H.Mill. & J.G.West, *sp. nov.*

A Stellaria multiflora *Hook. floribus subsessilibus, pedicelis fere minus quam 1 mm longis; capsula minus quam longitudine sepali; capsula valvis crassis et papillis angularibus tectis; seminibus grandibus, 1–2 per fructu, 1.3–1.9 mm longis, differt.*

Holotypus: Zara Wanganella via Hay [New South Wales], Oct. 1917, *E. Officer s.n*. (NSW 153113).

Stellaria sp. B sensu Doust in G.J.Harden, Fl. N.S.W. 1: 276 (1990).

Stellaria sp. 2 sensu C.H.Mill. & J.G.West in N.G.Walsh & Entwisle, Fl. Victoria 3: 239–240 (1996).

Stellaria sp. papillata (*E. Officer s.n. Oct. 1917*) C.H.Mill., Austral. Pl. Name Index database (APNI), http://www.anbg.gov.au/cgi-bin/apni [accessed 6 May 2010] & Austral. Pl. Cens. database (APC), http://www.anbg.gov.au/cgi-bin/apc [accessed 6 May 2010].

Illustration. C.H.Mill. & J.G.West in N.G.Walsh & Entwisle, Fl. Victoria 3: 236, Fig. 45u–v (1996).

Annual with slender taproot, glabrous; stems erect to ascending, to 10 (–15) cm long. *Stem and inflorescence leaves* a continuous series, sessile, linear to lanceolate, 2.5–10 (–15) mm long, 0.5–1 (–1.5) mm wide, acute, toothed or sparsely hairy on lower half of margin, occasionally appearing almost ciliate. *Inflorescence* a condensed monochasium of 3–15 (–26) flowers. *Pedicels* subsessile, (0.1–) 0.3–0.6 (–1.5) mm long, erect, smooth. *Sepals* (2–) 2.5–4.5 mm long, acute. *Petals* 1–5, 0.2–0.9 mm long, very reduced, shorter than half sepal length, shortly bifid or entire. *Stamens* 2–3. *Staminodes* 0–3. *Styles* 0.2–0.6 mm long. *Capsule* ellipsoid, rarely ovoid, (2.5–) 3–3.5 mm long, 1.5–2 mm wide, shorter than sepals; *valves* thickened, with angular papillae, straight, apex straight or incurved. *Seeds* 1–2, obloid to ellipsoid, (1–) 1.3–2 mm long, mid to reddish-brown; tubercles narrow ridges, semi-inflated. **Fig. 1J, 5H–O.** Flowering: (June–) Oct.–Dec. (–Apr.).

Distribution and habitat. A rare species from the south-west plains of New South Wales near Hay and Moulamein and north–western Victoria near Mildura (Fig. 6M)

S. papillata is found in riverine open shrubland, and degraded *Atriplex vesicaria* community now dominated by *Nitraria billardieri*, growing in heavy, grey deep-cracking clay loams.

Notes. Only five collections are known for *S. papillata*, despite further searching in the field. At least three of the populations have been found during systematic ecological surveys; the plants are often less than 2 cm high and are easily overlooked.

S. papillata has very distinctive capsule valves which are thick and covered in angular papillae, a character state that is not found in any other *Stellaria* in Australia. Additionally each capsule has one or two large broadly ellipsoid seeds.

Etymology. This species has been named from the Latin *papillatus*, papillate, reflecting the angular papillae on the capsule valves.

Specimens examined

New South Wales: Toganmain Stn, Darlington Point, 5 June 1969, *J. McKean 5189* (CANB); Approx. 10 km E of Moulamein, 25 Oct. 1972, *J.C. Noble 300* (NSW); Zara Wanganella via Hay, Dec. 1905, *E. Officer s.n.* (NSW).

Victoria: Adjacent to Murray River W of Mildura (S. bank), Keela Station, 1 Apr. 1987, *D. Cheal s.n.* (MEL)

10. *Stellaria pungens* Brongn.

in Duperrey, Voy. Monde, Atlas [part 16] Phan., Plate 78 (1834) [plate only, no description]. — **Lectotype (here designated):** Plate 78 '*Stellaria pungens*', Brongn. in Duperrey, Voy. Monde, Atlas [part 16] Phan. (1834).

Stellaria squarrosa Hook., J. Bot. (Hooker) 1: 250 (1834). — **Type Citation:** '*Mr. Lawrence*, (1831) *Mr. Gunn, (n. 96.)*'. **Lectotype (here designated):** Van D's Land, *Mr. Gunn No 96* (K, Herb. Hooker). **Residual syntypes:** Van Diemen's Land, *Mr Lawrence* (K, herb Hooker p.p.); Very common in rich soil in moist situations about the roots of shrubs which it frequently will ascend to the height of 3 to 4 feet, *Gunn 96* (K, Herb. Hooker p.p.).

Illustration. C.H.Mill. & J.G.West in N.G.Walsh & Entwisle, Fl. Victoria 3: 236, Fig. 45l–m (1996).

Perennial, prostrate to erect to 43 (–60) cm long with rhizome and rooting at nodes, sparsely to densely hairy. *Stem and inflorescence leaves* in a continuous series, sessile, lanceolate to ovate, rarely narrowly elliptic to linear, 3.8–13 (–17) mm long, 0.9–3 mm wide, usually pungent, margin usually with hairs, rigid. *Inflorescence* either axillary and solitary or an interrupted monochasium of up to 6 flowers. *Pedicels* (5–) 8–33 (–40) mm long, erect in fruit, sparsely hairy. *Sepals* (4.5–) 5–9.5 (–9.8) mm long, usually pungent, outer sepal margins hairy. *Petals* 4.2–8.3 mm long, longer than sepals, deeply bifid. *Stamens* 10. *Staminodes* 0. *Styles* (2.5–) 3–5.5 (–6) mm long. *Capsule* ovoid to narrowly ovoid or ellipsoid, (4.5–) 5–8.5 (–9.3) mm long, 2.5–3.5 (–4.3) mm wide, shorter than to longer than sepals; *valves* usually spreading, apex straight or recurved. *Seeds* (4–) 6–13 (–16), suborbicular to transversely elliptic, (1.1–) 1.3–1.8 mm long, light to mid greyish brown, appearing reticulate, tubercles rounded hills, inflated. **Fig. 1K, 5P–U.** Flowering: Oct.–Feb.

Common Name: Prickly starwort.

Distribution and habitat. Widespread along the tablelands and subalpine areas of the Great Dividing Range from northern New South Wales at Mt Kaputar through to southern Victoria, extending to Tasmania, including Bass Strait islands, and south-eastern South Australia (Fig. 6N).

Common herb, usually found in shady, moist places, in wet sclerophyll forests and woodlands, damp shady grasslands, or open grassland and shrublands. It grows in rocky areas, in sandy or clay loam soils, overlying granite, limestone, basalt and sandstones.

Notes. This is a very distinctive species that is readily identifiable in the vegetative state due to the pungent nature of its leaves and the hairiness of all organs.

Nomenclatural Notes.

Stellaria pungens Brongn. The original publication of the name *S. pungens* consists of a plate with no associated description. As no specimen has been located so far, the plate is here designated as the lectotype. It has been extremely difficult to date the actual publication of the plate illustrating *S. pungens*. The title page for the Atlas lists the year 1826 as the publication date, but the atlas was issued in 16 parts, this date is associated with the first part. It is known that parts 12 to 14 were published in Jan 1834 (Stafleu & Cowan 1976) but the last parts of the atlas, numbered 15 & 16 have no date associated with them. In addition to this, the name *S. squarrosa* was also published in 1834 in the 3rd fascicle of *Hooker's Journal of Botany* in July. As it is possible that the Atlas parts were published pre July 1834 it has been decided to continue to retain the use of *S. pungens* for this taxon as it has previously been applied, as this will be less disruptive.

The voyage of the *Coquille* travelled around South America, across to Tahiti across the north of New Guinea and associated islands, past the Molaccas and Amboina (Indonesia) and round the west and south of Australia to Port Jackson (Buck 1953). The boat remained in Port Jackson for just over a month before sailing on to New Zealand. The only place that *S. pungens* is known to grow on this route is somewhere on the eastern part of Australia. Maiden (1910) in discussing the voyage states that the Australian plants were all collected at Port Jackson. As the voyagers were there for a month it is possible they picked up a specimen from somewhere in the Blue Mountains where the species is quite common. At this time none of the specimens collected on this voyage have been seen.

Stellaria squarrosa Hook. Two sheets from Herbarium Hookerianum held at K contain type material. One sheet has the label 'no. 96 Mr Gunn Van Ds Land S. squarrosa Hook.'. The label is written in Hooker's hand and matches the protologue and this sheet has been designated here as the lectotype.

The second sheet has multiple collections. The top label on the RHS of the sheet has '1/710 V.D. Land. Beaches at D' entrecasteaux Channel J.D.H.' but does not match the specimen details in the protologue and thus is not considered to be type material. The second label in the middle of the sheet on the LHS is '96 Stellaria pungens Brong Very common in rich soil in moist situations about the roots of shrubs which it will frequently ascend to the height of 3 to 4 feet', however, while the location details match the protologue, the material does not match the lectotype material and is here considered to be a residual syntype. A third label is attached to a small portion of one specimen and has 'arenaria W of Fox's River' on it. This is a Cunningham collection from NSW and is not considered to be type material. At the bottom of the same portion is written on the sheet 'Van Diemen's Land. Mr Lawrence'. This information and the specimen match the protologue and it is thus considered to be a residual syntype.

Selected specimens (of c. 340 seen)

New South Wales: Near the Crackenback River at Thredbo Village, 25 Jan. 1964, *Hj. Eichler 17829* (AD); Summit area of Mt Kaputar, Mt Kaputar National Park, 24 Nov. 1987, *J.M. Fox 87/089* (CANB, NSW); Wyanbene Cave in NW corner of the Deua NP, 14 Oct. 1988, *W. Greuter 21301* (NSW); NT, 2.7 km along Barrington Trail S of Barrington Tops Forest Rd, Barrington Tops Conservation Area, 10 Dec. 2007, *J.R. Hosking 3014* (CANB); South Coast, Tuross river catchment area, 14 km N of Yowrie, 28 km NW of Cobargo, on N side of river, 1 Oct. 1978, *A. & C. Tyrrel, 153* (CANB).

Australian Capital Territory: Namadgi National Park, Glendale Crossing, SE of crossing, 15 Jan. 1992, *J.G. West 5287* (CANB, NSW).

Victoria: Brisbane Ranges, Stony Creek Picnic Reserve, 16 Nov. 1986, *B.J. Conn & D.B. Foreman 2493* (NSW); The Lakes National Park, Rotamah Island, Gippsland, 28 Oct. 1986, *I. Crawford 545* (CANB); Cape Conran, 6 Jan. 1969, *T. Henshall s.n.* (NT); Snowfields, Aberfeldy, 87 km N of Moe, 26 Dec. 1994, *P.C. Jobson 3331* (CANB, NSW);

Eastern highlands, 2.1 km E along Wheelers Creek Logging Road from Colac Colac to Benambra road; c. 38 km (direct) SSW of Corryong, 2 Dec. 1991, *R.O. Makinson & P. Carmen 905* (CANB); East Gippsland, Near summit of Mt. Seldom Seen, ca 10 km SW of Wulgulmerang (W ca 80 km NNW of Orbost), 6 July 1970, *A.E. Orchard 2729* (AD, NSW); Eastern Highlands region, SSW of Mt Jim, 14 Jan. 1999, *L. Spear 43* (CANB); Crossing of Bonang-Bendoc road over Delegate River, 25 Dec. 1985, *K.R. Thiele 1079* (CANB, NSW).

Tasmania: Ben Lomond National Park, Patersonia, 13 Dec. 1980, *A.M. Buchanan 342* (HO); North West Turners Beach, July 1986, *D.I. Morris 8631* (HO); Midlands, Kubla Khan Cave State Reserve ca 10 km W of Mole Creek township, 16 May 1983, *A. Moscal 2392* (HO); Central Highlands, Quamby Bluff (mid NE slope) 2 km SW of Golden Valley, Mar. 1986, *A. Moscal 12559* (HO); Kent's Group, Deal Island, Karitane Bay, 23 Nov. 1970, *J.S. Whinray 1235* (CANB).

South Australia: Mt McIntyre Swamps, 26 Dec. 1983, *R.J. Bates 3571* (AD); South-eastern, Mt. Burr Forrest, off Millicent–Glencoe Road, 14 Oct. 1991, *R.J. Bates 25991* (AD); South-eastern, Honans Scrub, On low rise in S of Park, 22 Nov. 1991, *R.J. Bates 26428* (AD); Hindmarsh Falls, about 11 miles N of Victor Harbour, 24 Oct. 1967, *R. & R. Belcher 453* (MEL); South-east district, Region 13, Penola Conservation Park. at eastern edge of picnic area, 29 Oct. 1986, *P. Gibbons 573* (AD, CANB).

Excluded Taxa

Stellaria decipiens Hook.f., Hooker's Icon. Pl. 7: t. 680 (1844).

Stellaria parviflora Banks & Sol. ex Hook.f., Bot. Antarct. Voy. II (Fl. Nov.-Zeland.) 1: 25 (1852).

The presence of these two taxa on Macquarie Island is discussed in Orchard (1993). There is some debate as to which taxon is on the island. Both species are native to New Zealand and do not occur anywhere else in Australia.

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Notes on *Hibbertia* (Dilleniaceae) 7. *H. hermanniifolia* group (subgen. *Hemistemma*) from mainly temperate eastern Australia

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Abstract

A taxonomic re-evaluation of the *H. hermanniifolia* group confirmed that it should be segregated from *Hibbertia* §*Tomentosae* Bentham (1863). The following taxa are recognised (newly described ones are in bold): ***H. acaulothrix*** Toelken, *H. hermanniifolia* DC. subsp. *hermanniifolia* and subsp. ***recondita*** Toelken, *H. hexandra* C.T.White, ***H. planifolia*** Toelken, ***H. reticulata*** Toelken, *H. spathulata* N.A.Wakef. subsp. *spathulata* and subsp. ***pleioclada*** Toelken. Desriptions, a key to the species and subspecies as well as illustrations are provided. The vestiture and its developments are reviewed.

Keywords: Dilleniaceae, *Hibbertia*, nomenclature, revision, taxonomy, eastern Australia.

Introduction

Bentham (1863) included in his taxon *Hibbertia* §*Tomentosae* species of the *H. melhanioides* and *H. tomentosa* groups (Toelken 2010) as well as the *H. hermanniifolia* group, which is here revised. All three together with other groups are now included in *Hibbertia* subgen. *Hemistemma* (Touars) Horn.

Hibbertia hermanniifolia was the first species of this. It was described by Candolle (1817) based on a collection by G. Caley from Dovedale near Sydney, but Bentham and subsequent botanists could not locate this second Dovedale, so that it was not recollected for 100 years. The second collection of it was only made in 1913 when E. Cheel and J.L. Boorman rediscovered it at what is now Bents Basin along the lower Nepean River (cf. Notes under *H. hermanniifolia*). The species occurs here only in one very restricted area and this is still the only locality from where typical *H. hermanniifolia* has been recorded.

Approximately thirty years later C.T. White collected in southern Queensland and described *H. hexandra* in 1942. He considered it to come "between *H. hermanniaefolia* and *H. velutina* R.Br." (White 1942, p. 201), the latter is here considered to be only distantly related to the complex as it is part of *Hibbertia* §*Tomentosae*, a taxon published by Bentham (1863) without rank (cf. Toelken 2010, p.1). The first collection from Victoria of another species different from *H. hermanniifolia* was described by Wakefield (1957) as *H. spathulata* N.A.Wakef. As more collections from Victoria followed the difference between these two species became less clear, but Willis (1973) distinguished *H. hermanniifolia* by its stalked fascicled hairs and stalked flowers. Since then more collections have become available from a number of populations with usually disjunct localities of the characteristic 'Inselberg' distribution so often found in hibbertias along the Great Divide. The present treatment attempted to evaluate and classify these divergent and disjunct populations, as many of them are now represented by several collections to provide a wider range of their local natural variation. However, this does not apply to three recent collections from the Northern Tableland of New South Wales which are here included as subspecies of *H. hermanniifolia* and *H. spathulata*. They are well out of hitherto known distribution ranges of the two species and require more field work.

Characteristics of the vestiture (cf. vestiture below) again proved a useful tool as in other groups of *Hibbertia* (Toelken 1998, 2000, 2010). Bentham (1863) largely followed Candolle (1824) when he placed *H. hermanniifolia* into his §*Tomentosae*, but Toelken (2010) noted that it is distinguished by normal fascicled hairs subtended on the upper leaf surface by base cells, while species of the §*Tomentosae,* consisting of the *H. tomentosa* and *H. melhanioides* groups, have rosette-like fascicled hairs or scales. Horn (2005, 2009) had already established this separation in his molecular analyses of the genus and family.

Characters

Leaves. The margins at the base of the leaf lamina continue into ridges or wings on either side of the persistent leaf bases on the branches. The leaves therefore seem sessile, but, similar to the more or less terete petioles in other parts of the subgen. *Hemistemma* (Thouars) Horn. They are also often variously elongated, so that the petiole is usually ill defined although approximate

measurements for this section of the leaf are provided in the descriptions. Species of the *H. hermanniifolia* group do not develop a marked ridge or wing from the base of the central vein on the undersurface of the leaves, which characteristically continues on the leaf base and the branches of species of the *H. tomentosa* and *H. melhanioides* groups (Toelken 2010).

No young seedlings have been recorded for this group, but juvenile plants about 10 cm tall, e.g. *G.L.Stebbins A-63,* NSW224829, without the basal leaves still had a few leaves which had two shallow subterminal teeth/lobes each with an obvious vein-end from a lateral vein more or less at the apex (Fig. 3I, 4B). Adult leaves including those of coppicing branches of *H. acaulothrix* (e.g. *S.Clarke s.n.*) are not lobed or toothed as has been recorded for the *H. tomentosa* and *H. melhanioides* groups (Toelken 2010). However, the leaves of *H. reticulata,* and rarely also in *H. hexandra*, exhibit short veinlets from the sinuate supermarginal veins to the leaf margins (Fig. 4H), but in contrast to those from juvenile leaves no obvious vein-ends were observed. These veinlets are also not continuations from the lateral veins to the leaf margin (unlike in juvenile leaves above), but seem to develop at irregular intervals, sometimes even several times, from the supermarginal between any two connections with lateral veins. No such veinlets were observed in any of the other species of this group even when the often dense tomentum was removed.

Vestiture. All species have predominantly fascicled hairs and in *H. reticulata* these are overtopped by hooked simple hairs on proximal margins of the leaf lamina. These hooked hairs are different to the occasional simple hairs on the upper leaf surface of, for instance *H. acaulothrix* (Fig. 1) which usually have a similar habit (including base cells, cf. below) to those of the surrounding fascicled hairs, which have arms varying in number (1–3) and size sometimes even on the same hair. Leaves of coppicing branches of the same species (*S.Clarke s.n.*) have mainly such simple hairs on the adaxial leaf surface, but even here they seem to merge into few multiangulate fascicled hairs of similar size and habit and are therefore grouped together.

These multiangulate fascicled hairs are, however, never found to become rosette-like as in the very similar species of the *H. melhanioides* and *H. tomentosa* groups, nor could the latter species be shown to have any multiangulate hairs, even in juvenile stages, although this would have been the obvious derivation of the rosette-like fascicled hairs (Toelken 2010).

The hairs on the upper leaf surface of adult as well as juvenile plants, as much as they are known, are often sparse and usually with very few arms. The leaves of seedlings of typical *H. hermanniifolia* (*G.L.Stebbins A-63,* NSW224829) examined had already lost the lowest about fifteen leaves, but still retained a few with shallow subterminal lobes or rounded teeth. These leaves had already a few hairs with short stalks on the abaxial surface, but the cover of sessile hairs below them was still more sparse than in adult leaves as also reported for the *H. melhanioides* and *H. tomentosa* groups (Toelken 2010).

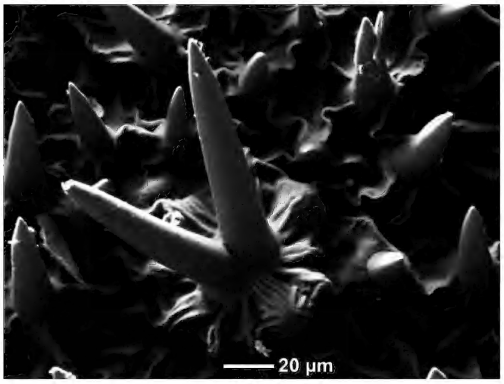

Fig. 1. *H. acaulothrix*. Adaxial leaf surface covered with erect fascicled hairs with 1-3 arms and subtended by a collar of ridged base cells. — *J.D.Briggs 2080.* — Leaf mounted on specimen holder and scanned uncoated using a JEOL Neoscope JCM-5000 Table Top SEM (Nikon, Tokyo) under low vacuum; accelerating voltage 15kV.

On the adaxial surface of mature leaves at least one row of epidermal cells form a collar around the base of each hair. The walls of these cells become thickened and often ridged (cf. Fig. 1). They stand out because they are often lighter than other green cells, and are similar to the **base cells** in the *H. aspera* group (Toelken 1998). Often they become very pronounced particularly when that leaf is very exposed and the hairs have worn off, so that eventually some leaves especially of *H. hexandra* are completely covered with such thickened cells. However, the base cells of leaves of *H. planifolia* and *H. spathulata* are usually bulging similar to 'goose-bumps' on human skin, but do not develop visibly thickened walls under the persistent dense hairs. They are even less well developed in *H. reticulata*.

Normally the base cells, which were only observed on the upper leaf surface, are only slightly raised above the surrounding epidermis and form a bulging or beady collar around each hair. On the undersurface of the leaves the stalked hairs, although not unique to this group (cf. *H. alopecotis*, Toelken 2010), are very well developed in *H. hermanniifolia*. The stalk is made up of cells similar to those of epidermis, which seem to have formed a protrusion, as the basal tubercle of the fascicled hair is found distally but partly hidden by a layer of epidermis-like cells. The cells of the stalks develop thick walls similar to the base cells and become filled with an amorphous brown substance, which is presumed to be tannins. This development of the stalk from the epidermis is further supported by the occasional presence of sessile fascicled hairs at the base or on the base of the stalk (Fig. 2) in the typical subspecies of *H. hermanniifolia*. The development of the stalks has,

however, not been studied as no seedlings with very immature leaves could be obtained.

Flowers. The terminal flowers are subtended by a bract that is always found immediately below the calyx as in the §*Tomentosae* but unlike the varying positions in the §*Vestitae*. The internode below the bract here referred to as peduncle (propodium; Conn 1995) is more or less elongated. In *H. hermanniifolia* subsp. *hermanniifolia* the internodes on the branches are usually elongate, so that one can more easily examine the flower buds, which are usually immediately overtopped by continued vegetative growth from the axil of the first leaf at the base of the peduncle. After at least two leaves another flower develops terminally and sympodial growth continues in a similar pattern to that described for *H. superans* (Toelken 2000, Fig. 11). As the branch thickens, the base of the slender peduncle is often pushed aside, so that it is usually not in a strictly leaf-opposed position, as it is commonly found in other Hibbertia species. In some dried specimens flowers may even seem axillary, but younger buds examined showed more clearly a terminal origin of the flowers.

The position of the flower is not quite so obvious in most specimens of *H. hermanniifolia* subsp. *recondita*, *H. aculothrix*, *H. planifolia* and *H. spathulata* partly because of lateral displacement, but mainly as a result of abbreviated internodes between the clustered leaves on distal branches, so that it becomes impossible to determine the position of the flowers.

In *H. hexandra,* and to lesser degree also in *H. reticulata,* flowers are also borne on elongated branches, but here the flowers are found terminal on fascicled lateral branches toward the apex of the main branches. Usually there are few such branches scattered along the upper reaches of larger branches. However, on actively growing branches the flowers occur in distal groups of these fascicled branches, at first on short lateral branches with few leaves. Higher up these leaves decrease in number and size acropetally to two caducous leaflets (up to 4 mm long) at the base of the peduncle in the axil of the uppermost leaves. These axillary flowers in such continuous inflorescences are born at successive nodes unlike the terminal flowers, which develop at intervals of several nodes/leaves, as also recorded for the §*Tomentosae* (cf. Toelken 2010, Fig. 12A).

Stamens. Five more or less clear bundles of stamens are arranged around the ovaries in most flowers. These bundles seem to agree with the stamen trunks, which divide up to provide vascular traces to the individual stamens (Wilson 1965, Tucker & Bernhardt 2000), as there are usually the same number of stamens in each bundle. Sometimes, particularly in flowers with more than 15 stamens, the dorsal two bundles (in relation to the bract) are more clustered, so that these bundles are less easily distinguished. However, the few stamens of *H. hexandra* are also not always clearly grouped (Fig. 4E).

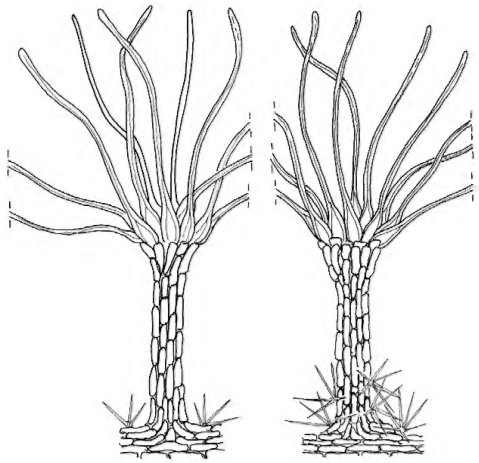

Fig. 2. *H. hermanniifolia* subsp. ***hermanniifolia***. Stalked fascicled hairs with sessile fascicled hairs at or sometimes on the base of the stalk ×30. — *I.R. Telford 7225.*

The stamens are variable in size and some of them are reduced to staminodes with more or less reduced, indehiscent anthers or anthers lacking (Fig. 3D, 4D). The number of staminodes varies from one plant to another. There are often more staminodes, or all of them occur in the lateral bundles. The fertile stamens are also variable in length and especially the central one (rarely few) of the dorsal bundle is usually considerably longer than others. The filament of the central stamen, as well as the anthers of the other stamens of that bundle are usually leaning over the ovaries, so that the large anther is usually placed between the bases of the two erect styles. Other anthers of different sizes are normally tightly arranged around this to form a broadening column downwards. The rotate flower with a central anther column is unusual in *Hibbertia* and resembles those of *Solanum* flowers, except that two styles on either side of the anthers are at first erect, but become strongly recurved, so that the stigmas are directed dorsally and well away from the anthers. The filaments are usually slightly longer in *H. elongata* and *H. spathulata*, and as a result the anthers in dried material are rarely close together. A similar arrangement, though not as tightly grouped, is also found in *H. hexandra*. Here, however, the styles remain more or less erect, as in some tropical species of the *H. melhanioides* group, where the anthers are also often unequally long (e.g. *H. bicarpellata*, Toelken 2010), but are not forming a central column. A similar spacial arrangement of the anthers and styles as in the *H. hermanniifolia* complex is also often observed in the *H. stricta* complex (Toelken 2010b) except here all the stamens are in one dorsal cluster. This spatial arrangement seems to represent a distinct feature of the pollinating syndrome.

Ovary. In all species of the *H. hermanniifolia* group the ovaries are densely hirsute with erect-spreading fascicled hairs. Similar to the species of the *H. melhanioides* group (Toelken 2010a) the style bases (Fig. 4F, 4J), particularly of *H. hexandra* and *H. reticulata,* are often to various degrees hairy. Other specimens of both the species vary to glabrous.

Seeds. The more or less lobed cup-shaped apex of the arils varies only slightly in length, similar to those in the *H. melhanioides* and *H. tomentosa* groups.

Taxonomy

Historically *Hibbertia hermanniifolia* was placed by Candolle (1817, 1824) into a group of species distinguished by the stamens being arranged around the densely hairy ovaries. Bentham (1863) largely agreed and named the group *Hibbertia* §*Tomentosae*. In that group Toelken (2010a) segregated the tropical species of the *H. melhanioides* and *H. tomentosa* groups from the *H. hermanniifolia* group mainly on the basis rosette-like hairs to scales as opposed to fascicled hairs, respectively.

H. hermanniifolia group

Shrubs with terete branches covered with raised leaf bases (not ridged or winged). *Vestiture* of multiangulate fascicled hairs with their base often surrounded by base cells with thickened lateral walls, or at first only radial walls thickened. *Leaves* cuneately linear-triangular to obovate, with lamina gradually constricted into indistinct petiole, truncate to cuspidate with scarcely recurved apex, sometimes emarginate, flat and with slightly revolute margins, lateral and intramarginal veins incompletely or not visible (except for mainly young leaves of *H. reticulata*); *juvenile leaves* broader, with a pair of rounded subterminal teeth/lobes but not repeated in coppicing leaves, with subterminal and terminal vein-ends. *Flowers* terminal on more or less reduced short shoots, hence sometimes appearing axillary, ± stalked, with narrowly ovoid to ellipsoidal buds; *bracts* linear to linear-spathulate. *Calyx* with lobes subequal to dissimilar, acute to cuspidate, ± ridged distally, with multiangulate fascicled hairs outside and inside. *Petals* entire to scarcely bilobed. *Stamens* 6–25 (–48), in groups around the ovaries, with varying numbers of staminodes; *anthers* linear-obloid, 1–3 longer ones. *Pistils* 2; *ovaries* each with 2 (–6) basal/ parietal ovules, densely fascicled-tomentose; styles erect on either side of stamens, with style base ± hairy.

Notes. This distinctive group is restricted to temperate areas (except *H. reticulata*) along mainly the eastern escarpment of the Great Divide in Queensland, New South Wales and Victoria, where the present taxa seem to represent local relics judging by their often very disjunct restricted distribution. Widely separated populations of, for instance, the subspecies of *H. hermanniifolia* and *H. spathulata* indicate that some of these species once were more widespread.

Affinities. Bentham (1863) placed *H. hermanniifolia* as the first species into the *Hibbertia* §*Tomentosae* next to the *H.* §*Vestitae* and *H.* §*Ochrolasiae* and included them in his sect. *Euhibbertia* (=sect. *Hibbertia*), because the stamens in their flowers are arranged around the ovaries. Based on molecular evidence all of these three groups are now separated from the species of *H.* subgen. *Hibbertia* and placed in the *H.* subgen. *Hemistemma* (Horn 2005, 2009). Furthermore Horn (2009) demonstrated that

Key to the species and subspecies based largely on floral characters

1. Lower surface of leaves without stalked fascicled hairs
- **2.** Peduncle > 5 mm long
  - **3.** Stamens 32–48; upper leaf surface with distinct rugose-reticulate veins; northern Qld ..... ***H. reticulata***
  - **3:** Stamens 6 (–12); upper leaf surface with only a distinct mainly central vein; Qld, NSW ..... ***H. hexandra***
- **2:** Peduncle ≤ 5 mm long
  - **4.** Undersurface of leaves not visible between revolute margins and central vein, which is ± obscured by dense vestiture; shrublets decumbent to prostrate; NSW ..... ***H. planifolia***
  - **4:** Undersurface of leaves well exposed between revolute margins and obvious central vein; shrubs erect to spreading
    - **5.** Bracts 7.8–10.4 mm long; NSW ..... ***H. acaulothrix***
    - **5:** Bracts 3.4–5.4 mm long
      - **6.** Leaves with scarcely recurved margins; upper leaf surface puberulous to tuberculate or glabrescent; Qld, NSW ..... ***H. hexandra***
      - **6:** Leaves with obviously revolute margins; upper leaf surface tomentose, rarely pubescent
        - **7.** Hairs on upper leaf surface with up to 8–10 (–14) arms; NSW ..... ***H. spathulata*** subsp. ***pleioclada***
        - **7:** Hairs on upper leaf surface with 2–6 (–8) arms
          - **8.** Undersurface of leaves with some shortly stalked hairs; hairs on upper surface of leaves with 2 or 3 (–5) arms; NSW, Vic. ..... ***H. hermanniifolia*** subsp. ***recondita***
          - **8:** Undersurface of leaves with sessile hairs; hairs on upper surface of leaves with 6–8 (–14) arms; Vic. ..... ***H. spathulata*** subsp. ***spathulata***

1: Lower surface of leaves with some stalked fascicled hairs
- **9.** Stalk of fascicled hairs 0.35−0.7 mm long; peduncle (9.4–) 10−15 (–17.7) mm long; stamens and staminodes 18–28; NSW ..... ***H. hermanniifolia*** subsp. ***hermanniifolia***
- **9:** Stalk of fascicled hairs 0.1−0.3 mm long; peduncle (2–) 3−7 (–9) mm long; stamens and staminodes up to 15; NSW, Vic. ..... ***H. hermanniifolia*** subsp. ***recondita***

the *H. hermanniifolia* group formed a separate clade and one of three sister clades is the *H. aspera* group. Toelken (2010a) divided the *H.* §*Tomentosae* into the *H. melhanioides* and *H. tomentosa* groups and here distinguishes the *H. hermanniifolia* group mainly on the basis of their rosette-like hairs or scales as compared to multiangulate fascicled hairs respectively.

The *H. hermanniifolia* and *H. aspera* groups, which had previously been widely separated, because of the different arrangement of the stamens, now demonstrate one of several cases in *Hibbertia* where Horn (2009) could show a switch from the original stamens around the ovaries to stamens in one group to one side of the ovaries in another. Morphologically this affinity is supported because, in contrast to the other two sister clades, both groups have flat leaves with a scarcely developed central vein and develop similar base cells (cf. vestiture) around the tubercles of the fascicled hairs on the adaxial leaf surfaces. While most of the species of the *H. melhanioides* and *H. tomentosa* groups have toothed/lobed leaves of juvenile and regenerating shoots (Toelken 2010a), the *H. hermanniifolia* group were here found to develop toothed leaves only on seedlings and all leaves in the *H. aspera* group are entire (Toelken 1998).

The *H.* §*Ochrolasiae* from Western Australia form according to Horn (2009) part of a sister clade to the *H. melhanioides* and *H. tomentosa* groups, while the *H.* §*Vestitae* from temperate eastern Australia are part of one of the other two clades separate from the *H. hermanniifolia* and *H. aspera* clades (cf. above). Both the *H.* §*Ochrolasiae* and *H.* §*Vestitae* have more strongly revolute leaves and a more well developed central vein.

Species of the *H. hermanniifolia* group are here alphabetically arranged in order to avoid renumbering them once the whole genus has been revised.

Hibbertia acaulothrix* Toelken, *sp. nov.

A H. hermanniifolia *floribus plus minusve sessilibus pilisque faciculatis sessilibus; a* H. spathulata *pilis simplicibus foliorum paginis supernis bracteisque longioribus calice differt.*

Typus: New South Wales, 10 km N Bemboka, 16.x.1986, *J.D.Briggs 2080* (holo.: NSW; iso.: MEL; CANB – n.v.).

Hibbertia hermanniifolia auct. non DC.: G.J.Harden & J.Everett in G.J.Harden, Fl. New South Wales 1: 300 (1990), pro parte.

Shrubs up to 1.1 m tall, with several stems, erect; branches bluntly ridged to scarcely flanged from the leaf base, tomentose or pubescent. *Vestiture* ± persistent, dense multiangulate fascicled hairs sometimes overtopped by larger broad-based ones on whole plant; *on branches* dense, with erect to spreading multiangulate fascicled hairs (6–9 often unequal arms) overtopped by

Key to species and subspecies based on vegetative characters

As the revolute margins and central vein often bear different hairs they are here, for convenience, excluded in the use of 'undersurface of leaves', which are therefore not synonymous with the abaxial leaf surface (cf. Toelken 1998, 2000). References to the central vein always apply to the abaxial leaf surface unless specified, because here it is usually clearly visible.

1. Upper leaf surface with ± rugose-reticulate veins, with hooked simple hairs towards the proximal margins overtopping fascicled hairs; Qld . . . . . ***H. reticulata***

1: Upper leaf surface without veins or with incomplete vein network, without hooked hairs overtopping fascicled hairs

2. Stalked fascicled hairs present on branches and veins of abaxial surface of leaves . . . . . ***H. hermanniifolia***

3. Stalk of fascicled hairs 0.35−0.7 mm long; peduncle (9.4–) 10−15 (–17.7) mm long; NSW . . . . . ***H. hermanniifolia*** subsp. ***hermanniifolia***

3: Stalk of fascicled hairs 0.1−0.3 mm long; peduncle (2–) 3−7 (–9) mm long; NSW, Vic . . . . . ***H. hermanniifolia*** subsp. ***recondita***

2: Stalked fascicled hairs absent on branches and leaves

4. Upper leaf surface sparsely hairy, becoming tuberculate or glabrescent; arms of hairs scarcely longer than basal tubercle; leaf lamina (4.6–) 6−18 (–22.8) mm broad; Qld, NSW . . . . . ***H. hexandra***

4: Upper leaf surface tomentose to hirsute; arms of hairs at least twice as long as basal tubercle; leaf lamina 1–5.4 (–8.3) mm broad

5. Upper leaf surface hirsute with arms of larger flaccid hairs 2−4 times longer than those on shorter hairs (particularly on flanks of cuneate base), fascicled hairs with 2 or 3 (–5 on margins) arms,not persistent; NSW . . . . . ***H. acaulothrix***

5: Upper leaf surface velvety to tomentose with arms of larger erect-spreading hairs scarcely longer than those of shorter ones, fascicled hairs with (3) 4−6 (–12 on margins) arms, persistent

6. Central vein ± obscured by dense vestiture; undersurface of leaves not visible between revolute margins and central vein, shrublets decumbent to prostrate; NSW . . . . . ***H. planifolia***

6: Central vein obvious; undersurface of leaves visible between revolute margins and central vein; shrublets erect to spreading . . . . . ***H. spathulata***

7. Hairs on upper leaf surface with up to 8–10 (–14) arms; NSW . . . . . ***H. spathulata*** subsp. ***pleioclada***

7: Hairs on upper leaf surface 2–6 (–8) arms

8. Undersurface of leaves with some shortly stalked hairs; hairs on upper surface of leaves with 2 or 3 (–5) arms; NSW, Vic. . . . . ***H. hermanniifolia*** subsp. ***recondita***

8: Undersurface of leaves with sessile hairs; hairs on upper surface of leaves with 6–8 (–14) arms; Vic. . . . . ***H. spathulata*** subsp. ***spathulata***

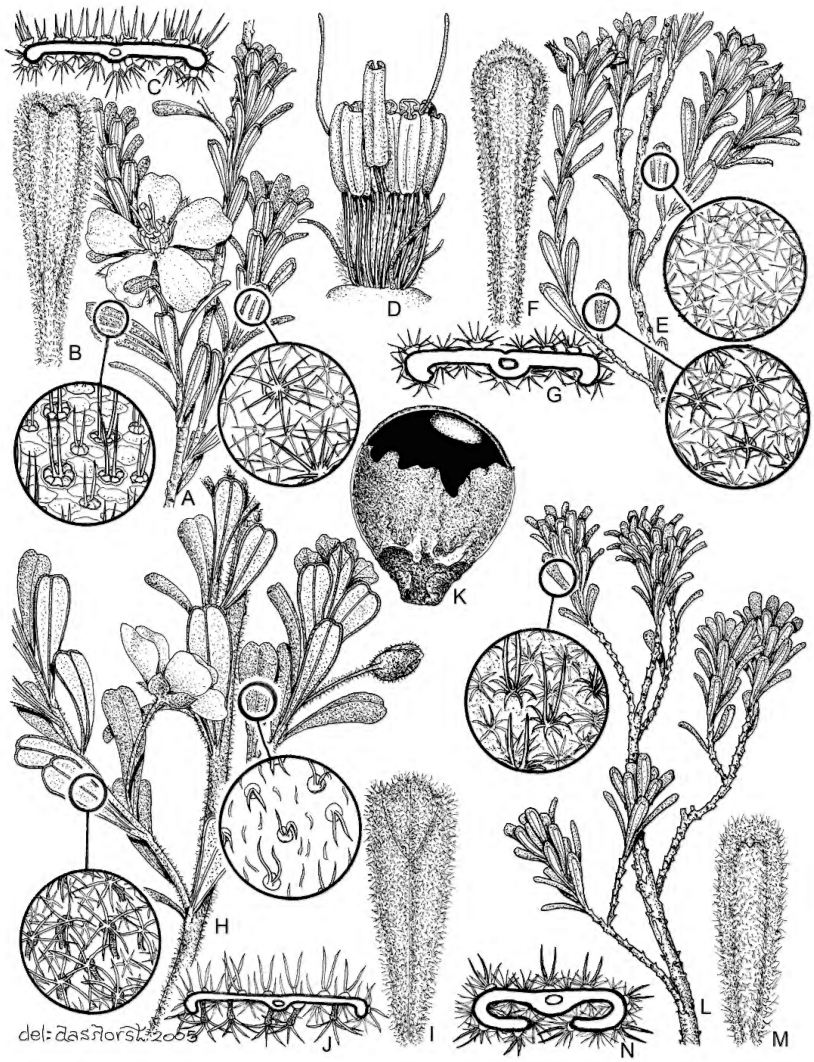

Fig. 3. A–D *H. acaulothrix*: **A** flowering branch ×1; **B** leaf from below ×3; **C** transverse section through mid-leaf ×9; **D** flower with calyx and corolla removed to show erect position of stigmas, 1 larger stamen and several staminodes ×10. **E–G *H. spathulata* subsp. *spathulata***: **E** branch ×1; **F** leaf from below ×4; **G** transverse section through mid-leaf ×10. **H–K *H. hermanniifolia* subsp. *hermanniifolia***: **H** flowering branch ×1; **I** juvenile leaf from above ×4; **J** transverse section through mid-leaf ×8; **K** seed ×10. **L–N *H. planifolia***: **L** branch ×1; **M** leaf from below ×4; **N** transverse section through mid-leaf ×9. — **A–D** *J.D.Briggs 2080*; **E–G** *N.G.Walsh 2209*; **H**, **J**, **K** *I.R.Telford 7225*, **I** *G.L.Stebbins A-63*; **L–N** *R.Coveney NSW 127188*.

or with scattered larger, often almost stalked broad-based ones (11–16 usually unequal arms); *on leaves above* moderately dense, spreading to antrorse, appearing sessile (basal tubercle surrounded by base cells) subequal multiangulate fascicled hairs (1–3 usually unequal arms or up to 5 on margin and often increasing 2–4 times the length towards the flanks) wearing off sooner or later; *on leaves below* scattered larger erect to spreading multiangulate broad-based fascicled hairs (7–14 unequal to subequal, antrorse to radial arms) over dense fine narrow-based multiangulate fascicled hairs (5–10 subequal arms, but not always distinguishable); *on bracts* above dense, with erect hairs (1–3 often unequal arms), below dense, with erect multiangulate fascicled hairs (6–9 subequal arms) or rarely with some broad-based ones (8–11 subequal arms) mainly on the central

vein; *on outer calyx lobes* outside dense, with mainly cactiform broad-based fascicled hairs or some erect multiangulate narrower-based fascicled hairs towards the margins and the apex, inside ± dense antrorse narrow-based fascicled hairs on upper third; *on inner calyx lobes* outside ± dense band of cactiform fascicled hairs along the centre becoming smaller laterally and with some fascicled cilia on the broad membranous margin, inside glabrous. *Leaves* without axillary tufts of hairs; *petiole* 0–0.3 mm long, indistinct; *lamina* cuneately oblong-oblanceolate, (4.6–) 6–15 (–22.3) × (1.6–) 2.5–4.5 (–5.4) mm, usually truncate-emarginate rarely rounded and with scarcely recurved vein-end, gradually constricted into petiole, flat, entire, above distinctly grooved along the central vein and puberulous or sometimes pubescent, becoming tuberculate, below with central vein broader and often raised above revolute margins or rarely with some lateral veins visible on upper half, velutinous, slightly discolourous; juvenile leaves (coppicing) larger but similar to normal leaves, entire, with finer and larger hairs. *Flowers* single, terminal, sessile or almost so, often on lateral shoots, with flower bud ellipsoidal; *penduncle* ± absent; *bracts* linear-oblanceolate to linear-spathulate, 7.8–10.4 × 1.9–2.4 mm, usually longer than outer calyx, pointed, ridged, below pubescent to tomentose or velutinous, above tomentose. *Calyx* with lobes slightly unequal but forming a range; *outer calyx lobes* (3/2) linear-lanceolate to -oblanceolate, (5.4–) 6–6.8 (–7.2) × 2.5–2.8 mm, scarcely longer than inner ones, pointed to acute, ridged, outside stubble-like to velutinous along margins, inside puberulous to pubescent on the upper third and the margins; *inner calyx lobes* (2/3) oblong-ovate, (4.2–) 4.5–5.5 (–6.3) × 3.1–3.8 (–4.1) mm, acute to cuspidate, scarcely ridged, stubble-like to pubescent on a central band and with fascicled cilia on broad membranous margin, inside glabrous. *Petals* obovate, (7.4–) 7.8–9.5 (–10.2) × (4.3–) 5.0–7.0 (–8.8) mm long, scarcely bilobed. *Stamens* 9–13 (plus some staminodes), subequal except for 1 (–3) longer ones, in ± 5 bundles around the ovaries; filaments narrow throughout, 1.3–1.8 mm long, slightly connate basally; *anthers* narrowly obloid, rarely obloid-ovoid, 1.1–1.3 mm long, 1 (–3) longer ones (1.8–1.9 mm long) in the centre, abruptly constricted above and below. *Pistils* 2; *ovaries* obovoid, each with 2 (–4) ovules above one another, hirsute, style attached to dorsal apex of ovary then ± erect such that stigmas are lateral to the upper part of the longer ± incurved anther(s). *Fruiting peduncle* not elongating. *Seeds* not seen. *Flowering*: usually October–April. **Fig. 1, 3A–D**.

Distribution and ecology. Recorded associated with sedimentary rocks from very different woodlands, such as with *Eucalyptus sieberi* L.A.S.Johnson or *E. multicaulis* Blakeley or associated with *Allocasuarina littoralis* (Salisb.) L.A.S.Johnson, *Corymbia gummifera* (Gaertn.) K.D.Hill & L.A.S.Johnson and *Leptospermum trinervium* (Sm.) Joy Thomps.; found in few widely separated localities in New South Wales (CT, CC, SC).

Conservation status. In Wadbilliga National Park "several thousand plants scattered over at least 3 ha." were recorded by *J.D.Briggs 2080*.

Diagnostic features. The vestiture of simple or scarcely branched fascicled hairs on the upper leaf surface is similar to that of *H. hermanniifolia,* but *H. acaulothrix* is distinguished by the absence of stalked fascicled hairs and flowers on elongated peduncles. Similarly the latter is distinguished from *H. spathulata* by the presence of simple hairs on the upper leaf surface, and bracts are longer than the calyx.

Variation. Although the species is at present known only from a few well separated localities, the different populations show little variation. Leaves of young fast-growing branches have usually predominantly simple hairs on the adaxial leaf surface and these and at least the larger hairs of the abaxial surface are more or less antrorse. Since a similar trend was found in both *H. hermanniifolia* and *H. spathulata* the absence of stalked fascicled hairs in this species is significant.

Etymology. The epithet "acaulo-thrix", Greek, "stalkless-hair" (noun in apposition) refers to the sessile hairs of this species in comparison to those of the very similar *H. hermanniifolia*.

Specimens examined

New South Wales: *S.Clarke s.n.*, Water Board land off Long Nose Point Road, 27.iii.2001 (WOLL); *M.D.Crisp 2235 & I.R.Telford*, 3.3 km E Mt Coricudgy, 27.x.1976 (CANB); *P.Gilmour WO33*, Brogo River near Yankees Creek, Wadbilliga National Park, 1.iv.1983 (CANB); *D.J.McGillivray 1605*, between Kekeelbon Mts and Mt Coricudgy, 13.ii.1966 (NSW); *D.Tilley WOLL 2113*, Wattle Ridge, Hilltop, iii.82 (WOLL); *T. & S.Whaite 3275*, Kekeelbon Mts, 1.ix.1969 (NSW).

***Hibbertia hermanniifolia* DC.**

Regn. Veg. Syst. Nat. 1: 431 (1817), as "*hermanniaefolia"*; Prodr. 1: 75 (1824), as "*hermanniaefolia*"; Benth., Fl. Austral. 1: 30 (1863), as "*hermanniaefolia"*; F.Muell., Syst. Cens. 1: 2 (1882), as "*hermannifolia*"; C.Moore, Census Pl. New South Wales 1 (1884), as "*hermannifolia*"; C.Moore & Betche, Handb. Fl. New South Wales 10 (1893), as "*hermannifolia*"; W.A.Dixon, Pl. New South Wales 29 (1906), as "*hermannifolia*"; N.C.W.Beadle et al., Vasc. Pl. Sydney edn 1: 194 (1963); J.H.Willis, Handb. Pl. Victoria 2: 386 (1973); G.J.Harden & J.Everett in G.J.Harden, Fl. New South Wales 1: 300 (1990); Toelken in N.G.Walsh & Entwisle, Fl. Victoria 3: 305 (1996). — **Type citation**: "in montibus Novae Hollandiae. Caley. (v. s. sp. in h. [dried specimen seen in herb.] Lambert)". **Type**: "m Lambert" (holo.: G-DC). — see Notes below.

Shrubs 0.8–1.5 (–3) m tall, with several stems, spreading; branches bluntly ridged to flanged from the leaf base, hispid to pubescent. *Vestiture* ± persistent, usually dense multiangulate fascicled hairs over whole plant but overtopped by few to many stalked ones mainly on branches, leaves below and outside of outer calyx lobes; *on branches* dense, with erect to spreading multiangulate narrow-based fascicled hairs (7–10 often

unequal arms) of different sizes overtopped by more or less spreading stalked broad-based ones (8–16 (–25) usually unequal arms) often near nodes; on *leaves above* sometimes wearing off but retaining basal tubercle and ring of base cells, moderately dense, with few to many erect simple to erect or spreading, often antrorse multiangulate narrow-based fascicled hairs (2, 3 often unequal arms, rarely up to 5 arms on the Northern Tableland, New South Wales) of different sizes, becoming larger (up to 12 arms) towards the flanks of the recurved margins; *on leaves below* dense, with fine spreading multiangulate narrow-based fascicled hairs of different sizes (7–10 subequal arms) overtopped by few to many stalked broad-based ones (11–16 (–23) usually unequal arms) mainly restricted to veins and the revolute margins; *on bracts* above moderately dense, with erect multiangulate narrow-based fascicled hairs (3–5 subequal arms), below like leaves dense, with spreading multiangulate narrow-based fascicled hairs of different sizes overtopped by few larger stalked broad-based fascicled hairs; *on outer calyx lobes* outside ± dense, with spreading, often short-branched multiangulate, often broad-based fascicled hairs of different sizes overtopped by ± stalked usually broad-based fascicled hairs scattered over the surface but becoming shorter towards the margins, inside with ± dense antrorse narrow-based multiangulate fascicled hairs on often more than the upper half; *on inner calyx lobes* outside ± dense, with spreading but short-branched multiangulate, often broad-based fascicled hairs of different sizes overtopped by scattered larger broad-based ones mainly along the centre and with narrow-based fascicled cilia on the membranous margins, inside glabrous except for a few antrorse fascicled hairs towards the apex. *Leaves* without axillary tufts of hairs; *petiole* 0.2–1.4 mm long, indistinct; *lamina* obovate to oblanceolate, 3.3–30.2 × 1.8–10.2 mm, usually ± truncate and with short recurved apex, usually entire, flat to ± folded lengthwise or grooved along the central vein and pubescent to sparsely velutinous, below with narrow central vein rarely raised above revolute margins and rarely with usually incomplete lateral veins visible towards the apex, and hirsute to velutinous, discolourous; juvenile leaves obtriangular, with three subequal terminal teeth, flat, covered at least at first with fine sessile fascicled hairs, each with few arms on the upper surface and with more on the undersurface. *Flowers* single, terminal or often not leaf-opposed but beside petiole, with ovoid to ellipsoidal buds; *peduncle* thread-like but firm, (3–) 4–12 (–17.7) mm long, terete; *bracts* spathulate to linear-oblanceolate, 3.3–5.5 × 0.8–2.9 mm, longer than half the outer calyx, leaf-like with revolute margins and central ridge, sparsely velutinous above and ± hirsute below. *Calyx* with lobes slightly unequal but forming a range; *outer calyx lobes* (3/2) linear-lanceolate to lanceolate, 5.1–7.4 × 1.8–3.1 mm, slightly longer than inner ones, ridged, outside hirsute rarely velutinous, inside pubescent with few antrorse fascicled hairs on upper half; *inner calyx lobes* (2/3) ovate, 5.1–6.4 × 3.6–4.2 mm, acute to obtuse, without ridge, tomentose to almost stubble-like towards the margins and with fascicled cilia along the membranous margins, inside glabrous to puberulous towards the apex. *Petals* oblong-oblanceolate, rarely obovate, 6.8–9.4 × 4.7–6.8 mm, scarcely bilobed. *Stamens* 9–24 (plus few staminodes) unequal, in 5 bundles around the ovary; filaments filiform, 1.1–1.5 mm long, scarcely basally connate; anthers narrowly obloid, 1.2–1.5 mm long, at least central one longer (1.8–2.1 mm), abruptly constricted above and below, straight. *Pistils* 2; *ovaries* obovoid, each with 2–4 ovules in pairs above one another, hirsute, with style attached to dorsal apex then more or less erect positioning stigmas laterally to the upper part of the longer anther. *Fruiting peduncle* slightly elongated, ± recurved. *Seeds* obovoid to almost spherical, 2.5–2.9 × 2.9–3.25 mm, shiny-black; aril with fleshy base expanding into ± 3 or 4 lobed cup-like membrane clasping the lower half of seed.

Diagnostic features. Pedunculate flowers and the uniquely stalked fascicled hairs with their commonly brown stalks, particularly on the undersurface of leaves, are distinctive of this species. Some of the latter hairs were always present, although they were found to grade into normal fascicled hairs with broad and thin tubercles. The discolourous leaves of this species are usually accentuated by the sparse tomentum of simple and fascicled hairs (with few arms) on the upper leaf surface, which is distinctive of the two subspecies.

The truncate leaves with a similar fascicled tomentum of vegetative material of some *Asterolasia* species (Rutaceae) have at times been confused with specimens of *Hibbertia hermanniifolia*.

Variation. The plants from the type locality, Bents Basin on the Nepean River, have particularly large leaves and hairs. They become smaller southwards in southern New South Wales and in Victorian plants often appear similar in size to those of *H. spathulata.* Throughout the distribution of the species the stalk of stalked hairs is more or less intensely brown-coloured, while the short base of sessile hairs is without colour. The same applies to less obviously stalked rosette-like fascicled hairs in *H. alopecota* from the Northern Territory and Duretto and Ladiges (1997) also report “often heavily pigmented” stalks of species of *Boronia*.

Similarly in the northern specimens the flowers are usually overtopped by axillary vegetative growth so that they appear to be axillary, because they are commonly pushed sideways. These flowers are rarely clearly leaf-opposed, nor do they show rudiments of axillary short shoots as it is observed in the tropical species. The specimen (*G.L.Stebbins A-63*, NSW224829) is the only one that has a number of terminal flowers but then the peduncles are typically longer than 9 mm.

The number of stamens and staminodes of a flower were found to vary from one population to another.

Notes. In the protologue Candolle (1817) cites the type as "in montibus Novae Hollandiae" and being a Caley specimen in Herb. Lambert, but none of this detail is found on the holotype specimen. A sheet (BM 834625) of this species contains four branches, one marked "in the Mountains – Caley" and a second "Dove Dale Oct 30-1807" in a different later handwriting (Bentham?). There is no indication whether they belong to the same collection or two different ones and which specimen then belongs to which collection, except that all four specimens are so similar that it seems likely that they are from the same plant of the only population this, the typical subspecies is known from. It could also not be established whether or not the Caley specimen/s in the British Museum are duplicates, i.e. possible isotypes particularly as Vallance et al. (2001) stated "Caley visited and revisited the place over the years."

The R.Brown specimen in Kew Herbarium was noted to have been received in 1880 (after flora treatment of Bentham, 1863) and is accompanied by a collector's label but without a number added subsequently by J.J. Bennett. This was found typical of that batch judging by other specimens. It is also annotated "Dove Dale Oct 30-1807" and thus unlikely to be collected by Brown. Vallance et al. (2001) suggested he and G.Caley could only have visited Dovedale on 23.x.1803, but no such specimen could be located.

A note concerning the exact locality of this Dovedale, which Bentham was unable to resolve, was found in the cover of the species in the National Herbarium of New South Wales (NSW):

"The type of this species was collected by Caley at 'Dovedale' (cf. Benth. [1863]) or, as cited by DC., 'in montibus Novae-Hollandiae'. This Dovedale (see label on specimen of leaf from Nat. Herb. Vict. Mel.) is at Bent's Basin, Nepean River. There was also another early property named 'Dovedale' on the Bellinger River (see Balliere's N.S.W. Gazetteer & Road Guide compiled by R.P.Whilworth 1866) & and this must have lead Moore & Betche [1893 and Dixon 1906] to cite 'Clarence River District' in the Fl. N.S.W. Caley's collections were from the Central Coast & too early for a N. Coast area. N.C.F. [Neridah C. Ford] 6/1957".

The species consists of many, often disjunct populations which are here grouped into two subspecies. The subsp. *hermanniifolia* is, however, restricted to a small area at Bents Basin.

Key to subspecies

1. Stalk of fascicled hairs 0.35–0.7 mm long; peduncle (9.4–) 10–15 (–17.7) mm long; combined stamens and staminodes 18–28; NSW . . . . . subsp. ***hermanniifolia***

1: Stalk of fascicled hairs 0.1–0.3 mm long; peduncle (2–) 3–7 (–9) mm long; combined stamens and staminodes up to 15; NSW, Vic. . . . . subsp. ***recondita***

***Hibbertia hermanniifolia* subsp. *hermanniifolia*.**

Leaves broadly obovate, (5.6–) 7–18 (–30.2) × (2.2–) 30–75 (–10.2) mm; stalk of fascicled hairs 0.35–0.7 mm long. *Flowers* usually overtopped by axillary vegetative growth displacing the peduncle to a lateral position; *peduncles* (9.4–) 10–15 (–17.7) mm long; *bracts* oblanceolate-spathulate, 1.9–2.9 mm broad. *Stamens and staminodes* 18–28. *Flowering:* September–February. **Fig. 2, 3H–K**.

Distribution and ecology. Grows on sandy soils or rocky slopes associated with sandstone cliffs in sclerophyll eucalypt forest of mainly *Corymbia eximia* (Schauer) K.D.Hill & L.A.S.Johnson and *Eucalyptus pilularis* Sm. in New South Wales (CC).

Conservation status. Locally common in conserved area.

Variation. Judging by a number of specimens collected at this restricted population it would seem that this subspecies shows little variation. Even juvenile plants are remarkably similar to adult plants (see description).

Specimens examined

New South Wales (all from Bents Basin): *D.Benson et al. NSW 167541*, 20.ii.1984 (NSW); *R.Brown [G.Caley] s.n.*, Dove Dale, 30.x.1807 (BM, K); *E.Cheel & J.L.Boorman NSW 33652*, 10.ix.1913 (BM, BRI, CANB, K, MEL, NSW); *J.Pulley 897 & I.R.Telford*, 29.ix.1971 (CANB); *G.L.Stebbins A-63*, 20.xi.1974 (CANB, NSW); *I.R.Telford 7225*, 27.x.1978 (CANB).

Hibbertia hermanniifolia* subsp. *recondita* Toelken, *subsp. nov.

A subspecie typica pedunculis brevibus usque ad 9 mm longis, pilis brevibus foliisque parvis differt.

Typus: Victoria, Mt Elizabeth 2, *R.D.Hoogland 11911*, 26.xi.1970 (holo.: AD98040099; iso.: BRI, MEL, NSW; A, B, BM, CANB, E, G, HBG, K, L, NE, OKLA, PERTH, UC – n.v.).

Hibbertia hermanniifolia auctt. non DC.: Willis, Handb. Pl. Victoria 2: 386 (1973), pro parte; G.J.Harden & J.Everett in G.J.Harden, Fl. New South Wales 1: 300 (1990), pro parte; Toelken in N.G.Walsh & Entwisle, Fl. Victoria 3: 305 (1996), pro parte.

Leaves oblanceolate to obovate, (3.3–) 4–8.5 (–13.5) × (1.8–) 2.5–4 (–5.6) mm; stalk of fascicled hairs 0.1–0.3 mm long. *Flowers* not overtopped by axillary vegetative growth, or if displaced by some growth then peduncle leaf-opposed; *peduncles* (2–) 3–7 (–9) mm long; *bracts* linear-oblanceolate, 0.9–1.4 mm broad. *Stamens and staminodes* up to 15. *Flowering*: August–February.

Distribution and ecology. Grows on dry slopes or on skeletal soils in rock outcrops, often on granite, in shrub land to sclerophyll forest in southern New South Wales (NT, SC) and north-eastern Victoria (EHL, EG).

Conservation status. Locally common on Mt Poole, New South Wales (*J.D.Briggs & D.E.Albrecht 1957A*) and Mt Elizabeth 2, Victoria (*F.E.Davies 640*).

Variation. Specimens from widely separated localities on the Northern Tablelands are remarkably similar to the southern populations of this subspecies. Even the number of stamens, the most critical character that separates

the two subspecies, fall into a similar range, although only few flowers from the northern populations have been available for examination. While one specimen (*L.M.Copeland 3446*) has a vestiture remarkably similar to the southern populations (even with base cells being visible around each hairs on the upper leaf surface), *P.Gilmour 8373* has very few stalked hairs on the leaves and these stalks are shorter than normal for this subspecies, and hairs on the upper leaf surface have up to five arms on the margins. Since the two specimens were collected relatively close to one another the two were combined until more material becomes available to evaluate the variation.

As the latter specimen has only few, shortly stalked hairs it might easily be confused with *H. spathulata* subsp. *pleioclada*, also from the Northern Tableland, but that subspecies can be easily distinguished by fascicled hairs with 5–10 arms on the upper leaf surface.

Most specimens of this subspecies can be recognised by their smaller leaves, but in the extreme large range there is an obvious overlap with those of typical *H. hermanniifolia*. One unusual specimen from between Mt Wellington and Castleburn (*Chesterfield MEL530993*) has, however, very large leaves (extreme measurements of 21.7 × 9.8 mm), but the hairs are much smaller (arms of stalked fascicled hair being 0.1–0.2 mm long), so that this specimen is here accepted as a form, possibly coppicing and still without flowers, of subsp. *recondita*, although this variant falls well outside the known range. The vestiture of this specimen also does not fit any species of *Asterolasia* (Rutaceae), which are at times confused with vegetative material of this species of *Hibbertia*.

Etymology. The epithet "recondita", Latin, "hidden, not easily seen" refers to the terminal flower buds, which are usually covered up by, or enclosed in the leaves around them because of the short peduncles.

Selection of specimens examined (36 seen)

New South Wales: *J.D.Briggs & D.E.Albrecht 1957A*, Mt Poole, Yumbulla State Forest, 16.vii.1986 (CANB, NSW); *L.M.Copeland 3446 & P.Lupica*, near Steepdrop Falls, ca 40 km ENE Walcha, 24.x.2002 (AD); *L.M.Copeland 3864, I.R.Telford & J.Duncan*, 100 m NNW Moona Falls, ca 30 km E Walcha, 30.xi.2004 (AD, CANB, NE, NSW); *P.Gilmour 8373*, ca 5 km NNE Limbri, 24.ii.2003 (AD); *K.Mills NSW 224830*, Mt Dunagh, Tantawangalo State Forest, 30.xi.1987 (NSW); *R.Outhred NSW 224833*, Yankees Gap, Wadbilliga Park, 1.iv.1983 (NSW).

Victoria: *D.E.Albrecht 296*, Camp Oven Gap track, W Timbarra, 18.iii.1984 (CANB, MEL); *A.C.Beauglehole 37113*, Mt Elizabeth 2, N side, 28.ii.1971 (AD, MEL, NSW); *37144*, Collins Road, 5.3 miles from Omeo Highway, 1.iii.1971 (MEL, NSW, CANB); *F.E.Davies 640*, Mt Elizabeth, 12.xi.1988 (AD, CBG, HO, MEL, NSW); *E.A.Chesterfield MEL 530993*, on Dargo Road between Mt Wellington & Castleburn, 11.iii.1978 (MEL); *J.R.Turner 18*, Mt Steve, 25.ix.1984, (MEL); *J.H.Willis MEL502085*, Mt Elizabeth summit, 16.ix.1968 (MEL, NSW).

***Hibbertia hexandra* C.T.White**

Proc. Roy. Soc. Queensland 53: 201 (1942); N.C.W.Beadle, Student. Fl. N.E. New South Wales 3: 250, fig. 117C (1976); Stanley in Stanley & E.M.Ross, Fl. S.E. Queensl. 1: 188 (1983); G.J.Harden & J.Everett in G.J.Harden, Fl. New South Wales 1: 300 (1990); Jessup in Bostock & E.E.Holland, Census Queensl. Fl. 64 (2007). — **Typus**: Queensland, Lamington National Park, *C.T.White 11187*, 22.xi.1934 (holo.: BRI).

Shrubs to small trees recorded up to 5 m, but usually not more than 3 m tall, erect; branches bluntly ridged, tomentose. *Vestiture* ± persistent, with erect to spreading, rarely reflexed multiangulate fascicled hairs on all parts of the plant; *on branches* dense, with erect to spreading smaller multiangulate fascicled hairs (8–15 often unequal arms) overtopped by scattered larger ones (11–22 often unequal arms); *on leaves above* sparse, with scattered larger and smaller multiangulate fascicled hairs (with broad base and 2–4 short subequal and often only with antrorse arms, usually wearing off but with tubercle remaining or rarely only tubercles developing) with slightly larger ones towards and on the flanks of the revolute margins; *on leaves below* dense, with subequal erect multiangulate fascicled hairs (7–12 subequal arms) overtopped by few distinctly larger ones (15–18 subequal arms) mainly associated with the veins; *on bracts* above and below dense, with subequal erect multiangulate fascicled hairs overtopped by very few larger ones on the central vein; *on outer calyx lobes* outside dense, with subequal spreading multiangulate fascicled hairs overtopped by more or less larger ones often with many arms, inside densely covered with subequal multiangulate fascicled hairs (but more or less antrorse) on the upper two-third to half; *on inner calyx lobes* outside like outer calyx but with fewer larger hairs, inside with few antrorse multiangulate hairs towards the apex. *Leaves* without axillary tufts of hairs; *petiole* (0–) 0.4–2.0 (–6.6) mm long, often indistinct; *lamina* elliptic- to oblanceolate, (8.2–) 15–50 (–75.6) × (4.6–) 6–18 (–22.8) mm, rounded to slightly emarginate, rarely obtuse, gradually tapering into petiole, flat with slightly recurved margins, entire rarely slightly sinuate towards the apex and associated with veins to the margins, above slightly grooved along the central vein and puberulous often becoming tuberculate to glabrous, below with more or less raised veins showing the central vein connected to lateral ones at 70–85° and continued onto sinuate inframarginal ones, tomentose to hirsute along the major veins, distinctly discolourous; juveniles leaves (*L.J.Webb & J.G.Tracey BRI 37332*) oblanceolate, with 1, rarely 2, rounded teeth on either side below the rounded apex and continued for up to 30 leaves, occasionally repeated on fast growing branches, flat with hardly recurved margins, above with scattered fascicled hairs (2, 3 subequal arms), scarcely tuberculate at first, but soon tubercles form and arms wear off, below with few scattered hairs along the veins, each with 3–5 subequal arms, becoming densely hairy (tomentose) on the 17th to 20th leaves. *Flowers* single, terminal on short

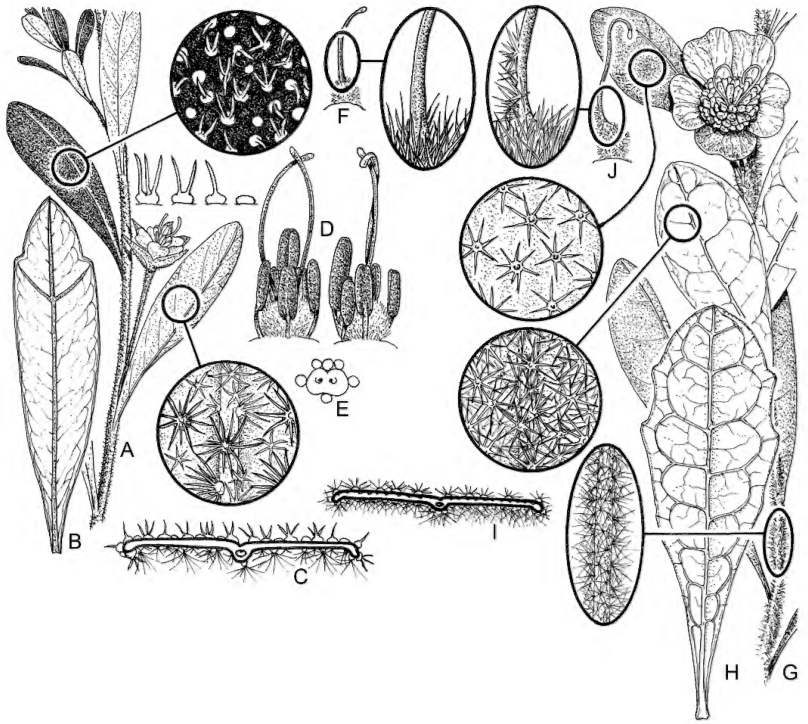

Fig. 4. A–F *H. hexandra*: **A** flowering branch ×1; **B** juvenile leaf from below x1; **C** transverse section through mid-leaf ×5; **D** flower with calyx and corolla removed in frontal and lateral view ×9; **E** diagram of stamens around ovaries; **F**, style base ×8; **G–J *H. reticulata***: **G** flowering branch ×1; **H** juvenile leaf from below ×1; **I** transverse section through mid-leaf ×3; **J** hairy style base ×8. — **A, C–F** *I.R. Telford 1170*; **B** *I.R. Telford 3303*; **G–J** *M.B. Thomas 296*.

shoots along branches but distally progressively reduced to "axillary" with ultimately two caducous leaflets up to 4 mm long in axil of subtending leaf, with buds narrowly ovoid to ellipsoidal; *peduncle* stiff, 3.1–7.0 (–16.8) mm long, terete to slightly ridged below the flowers; *bracts* strap-like to linear-oblanceolate, linear-spathulate, 3.4–4.8 × 0.4–1.2 mm, ca half to two-thirds as long as outer calyx lobes, acute to pointed, erect and ± appressed, tomentose. *Calyx* with lobes unequal; *outer calyx lobes* (3), lanceolate to oblong-lanceolate, 6.2–7.0 (–7.7) × (1.7–) 1.9–2.2 mm, usually distinctly longer than inner ones, acute, usually distinctly ridged along the whole length, outside tomentose interspersed with larger hairs, inside tomentose to pubescent on upper two-third to half; *inner calyx lobes* (2) oblong-ovate, 5.4–5.9 (–6.1) × 2.6–3.1 mm, acute, with faint ridges, outside tomentose and membranous margins with some fascicled cilia, inside tomentose to puberulous towards the apices. *Petals* oblanceolate to oblong-oblanceolate, 5.2–8.4 mm long, usually entire. *Stamens* 6 (–12) (without staminodes), unequal, with dorsal one longer, arranged in groups around pistils; *filaments* strap-like, 1.1–1.4 mm long, scarcely connate basally; *anthers* narrowly obloid, 1.6–1.8 (–2.1) mm long, abruptly constricted above and below, straight. *Pistils* 2; *ovaries* broadly obovoid to almost spherical, with 2 basal to parietal ovules, hirsute, with style attached to the apex then spreading straight out- and backwards with stigmas near the petals. *Fruiting peduncle* scarcely elongating, slightly recurved. *Seeds* obloid, 3.2–3.35 × 2.1–2.2, dark brown; aril with fleshy attachment expanding into a cup-like, ± lobed membrane covering lower third to one side of the seed. *Flowering*: Flowers have been recorded for all months of the year. **Fig. 4A–F**.

Distribution and ecology. Grows usually on shallow soil on volcanic rocks in heath or forest margins but also sometimes in adjoining rainforest vegetation in Queensland (Dd, Mo, Wb) and northern New South Wales (NC).

Conservation status. Recorded from and conserved in a number of parks in Queensland and New South Wales.

Diagnostic features. The species is distinguished from others in this group mainly by its usual six stamens, but as this number is occasionally variable, its vestiture of the leaves, and in particular on the upper surface of the leaf, is different, especially from *H. hermanniifolia* and *H. spathulata* subsp. *pleioclada*.

Variation. All parts of plants of this species are extremely variable, but the difference between leaves on fast growing shoots as opposed to senescent flowering ones as found in most hibbertias, is here particularly pronounced. Leaves of the former also usually have distinct petioles, while in the latter they are often ill-defined. The leaves of plants from Mt Greville (*P.I.Forster 4698*) and Mt Maroon (e.g. *S.J.Everist 7172*) are usually narrower and have often obviously larger hairs on the flanks of the recurved margins, sometimes larger numbers of stamens and, most interestingly, hairy style bases of varying degrees. However, no two of these characters allow at present a consistent delineation of an infraspecific taxon.

Unusual for this species is its outer and inner calyx lobes are often very similar in shape, but they are described separately, because the inner two are usually slightly smaller than the outer three. The number of stamens, commonly six in each flower, was occasionally found to vary to eight or even twelve (e.g. *S.J.Everist 7172*), placing it into the same range as in, for instance, *H. spathulata* subsp. *pleioclada*, but this taxon has a different vestiture, especially on the upper surface of the leaves. The tropical species, such as *H. velutina*, to which White (1942) compared *H. hexandra*, have much higher numbers of hairs as well as the different rosette-like fascicled hair type.

Selection of specimens examined (28 examined)

Queensland: *E.J.Carroll 1170 & I.R.Telford*, Koongalala Point, Coomera Gorge, 27.v.1967 (CANB); *S.L.Everest 7172*, Logan River E of Mt Maroon, 2.iv.1962 (BRI, CANB); *M.Fagg 616*, Binna Burra, Coomera Falls track, 12.v.1970 (AD, CANB); *P.I.Forster 4698*, Palm Grove Gorge Mt Greville, 21.viii.1988 (BRI, NSW); *E.J.Smith 9*, Mt Greville Gorge, 20.iv.1938 (BRI); *G.L.Stebbins A-81*, SE Binna Burra Lodge, 7.i.1975 (CANB); *R.F.Thorne 20394 & S.T.Blake*, Roberts Plateau, Binna Burra, 5.iv.1959 (BRI, CANB); *C.T.White 7281*, Mt Greville, 9.vi.1963 (BRI).

New South Wales: *R.D.Hoogland 11807*, Whian Whian State Forest, 16.x.1970 (BRI, CANB); *L.A.S.Johnson & E.F.Constable NSW 86478*, Whian Whian State Forest, 10.vi.1957 (NSW); *I.R.Telford 3303*, Nightcap Range, 2 km N Peach Mtn, 29.ix.1973 (CANB); *C.T.White 12840*, Whian Whian State Forest, 2.vi.1924 (BRI, NSW); *M.G.White NSW 86479*, Kippara State Forest, 20.iv.1957 (NSW).

Hibbertia planifolia* Toelken, *sp. nov.

A H. spathulata *et* H. acaulothrix *habitu decumbente, foliis ut videtur planis vena centrale invisibile differt.*

Typus: New South Wales, Yerranderrie, *J.L.Boorman s.n.*, vii.1915 (holo.: NSW 101917; iso.: CANB – n.v.).

Prostrate shrublet ca 0.3 m high, ± decumbent, much branched, with leaves clustered terminally; branches terete with distinctly raised leaf base but these are not drawn into flanges, tomentose. *Vestiture* persistent, dense, with subequal (in size not number of arms) erect-spreading multiangulate usually narrow-based fascicled hairs on most parts of the plants; *on branches* with few slightly larger multiangulate, rarely broad-based fascicled hairs (9–14 usually unequal arms) mainly near leaf bases with/over a dense cover of smaller ones (7–10 unequal or subequal arms); *on leaves above* dense, with erect to antrorse subequal (becoming longer and with more arms towards the margins) multiangulate narrow-based fascicled hairs (5–10 subequal to unequal some longer arms); *on leaves below* very dense, with slightly larger spreading multiangulate often broad-based fascicled hairs (8–12 subequal arms) mainly on the central vein over or rarely with a very dense cover of smaller narrow-based ones (5–8 subequal arms, but usually not well discernable); *on bracts* above and below dense, with erect-spreading but often somewhat antrorse narrow-based (except for a few larger ones on the margins) multiangulate fascicled hairs (7–12 usually subequal arms), subequal to slightly longer along the margins; *on outer calyx lobes* outside very dense, with erect to spreading narrow-based multiangulate fascicled hairs (6–10 subequal arms becoming longer and often unequal along the margins), overtopped by few spreading broad-based ones, mainly along the central ridge, inside moderately dense antrorse narrow-based fascicled hairs on the upper third; *on inner calyx lobes* outside dense, with small spreading to reflexed narrow-based multiangulate fascicled hairs (with short arms except along the faint central ridge) along a central band and becoming gradually smaller towards the broad lateral membranous margins, ± topped with fascicled cilia, inside glabrous, or rarely with few fine antrorse hairs towards the apex. *Leaves* without axillary tufts of hairs; *petiole* 0–0.3 mm long, indistinct; *lamina* linear-obtriangular, rarely linear, (3.3–) 3.5–4.8 (–6.3) × 1.0–1.3 mm, truncate, rarely obtuse when young, becoming ± recurved-spreading when older, cuneate from apex to petiole, flat, above scarcely grooved along the central vein and tomentose, below central vein recessed between recurved margins being densely tomentose and scarcely visible, discolourous; juveniles leaves not seen. *Flowers* single, sessile in terminal clusters of leaves, with ovoid to ellipsoidal buds; *peduncle* ± absent; *bracts* linear to club-shaped, 5.4–5.6 × 0.9–1.05 mm, almost as long as outer calyx, usually obtuse, semicircular in section, tomentose above and below. *Calyx* with lobes scarcely unequal and forming a range; *outer calyx lobes* (3/2) lanceolate to narrowly ovate, 5.3–5.6 × 2.3–2.9 mm, slightly longer than inner ones, pointed, ridged and with ± recurved margins, outside tomentose to hirsute along ridge and margins, inside pubescent on upper half to third; *inner calyx lobes* (2/3) ovate, 3.8–4.2 × 3.3–3.6 mm, obtuse to cuspidate, rarely almost rounded, with faint ridges, outside pubescent to puberulous, rarely stubble-like along the centre and short, fine, often fascicled, cilia on a broad membranous margin, inside usually glabrous. *Petals* obovate, 5.3–6.3 mm long, slightly bilobed. *Stamens* 8–11 (plus up to 10 staminodes), subequal except one, in groups around the ovary; *filaments* filiform, 1.0–1.15 mm long, scarcely fused basally; *anthers* narrowly oblong-ovoid, 0.9–1.25 mm long, longer one 1.85–2.0

mm long, abruptly constricted above and below. *Pistils* 2; *ovaries* obovoid, each with 2 basal ovules, tomentose, with style attached to the centre and then erect on either side of the central cluster of anthers and with constricted stigmas well above even the longer anthers. *Fruiting peduncle* ± absent. *Seeds* not seen. *Flowering*: July–September. **Fig. 3L–N**.

Distribution and ecology. Grows in rocky places on sandstone with scrub vegetation in south-eastern Central Tableland of New South Wales (CT).

Conservation status. It is only known from two collections and the species has not been collected for forty years.

Diagnostic features. The species is distinguished from the very similar *H. spathulata* by its decumbent to prostrate growth, flat leaves with the central vein ± recessed between the revolute margins and an apex that is only slightly recurved, the almost linear bract, and the greater number of stamens and staminodes (18–22 as apposed to up to 15 in the latter species). A narrow-leaved form of *H. spathulata* (*R.D.Hoogland 11922*), though superficially similar, is also easily distinguished from *H. planifolia* by the very prominent central vein and more or less folded leaves.

A similar difference in the number of the stamens exists between *H. planifolia* and *H. acaulothrix*, which appears to be a more robust form of the former, because its central vein is underdeveloped but well visible, as is the undersurface of the leaf between the vein and the revolute margins. *Hibbertia acaulothrix* has also fewer arms (1–4 versus 5–14 in *H. planifolia*) on hairs on the upper leaf surface as well as hairs with distinctly longer arms on the flanks.

Variation. Young leaves are erect and similar to those of *H. acaulothrix*, but become recurved-spreading as they get older quite unlike that species.

Etymology. In contrast to all members of the *H. hermanniifolia* complex the central vein of this species seems hardly raised and scarcely distinguishable between the recurved margins, but partly also because of a dense cover of hairs. They appear "flat-leaved", which is referred to in the Latin epithet "plani-folia".

Specimens examined

New South Wales: *R.Coveney NSW127188*, Mt Colong, 16.ix.1967 (NSW).

H. reticulata* Toelken, *sp. nov.

A H. hermanniifolia *et* H. hexandra *32–48 staminibus pilisque fasciculatis adpressis superantibus pilis simplicibus in paginis adaxialis foliorum;* H. melhanioides *nervatura foliorum reticulata, calicis et ovariis pilis fasciculatis differt.*

Typus: Queensland, Cook district, Tozer Gap, *B.J.Conn 3787 & A.N.L.Doust*, 5.vi.1993 (holo.: AD; iso.: BRI, NSW – n.v.).

Hibbertia sp. (Mt Tozer L.J.Brass 19024) S.T.Reynolds in R.J.F.Henderson, Queensland Pl. 65 (1997).

Shrubs up to 2 m tall, with erect to spreading branches; branches ± woody, bluntly angular from the centre of the leaf base, tomentose. *Vestiture* persistent, with spreading to reflexed multiangulate, mainly narrow-based fascicled hairs on the whole plant, rarely interspersed with hooked simple hairs; *on branches* densely covered with spreading multiangulate fascicled hairs (5–8 subequal arms), rarely interspersed with few slightly larger ones but not overtopping; *on leaves above* with scattered, often subequal ± appressed multiangulate ± broad-based fascicled hairs (4–6 (–8) subequal to unequal ± reflexed short arms) of more or less the same size, overtopped on young leaves by scattered hooked simple hairs mainly on the proximal flanks; *on leaves below* very densely covered with subequal fine spreading multiangulate fascicled hairs (6–12 subequal often reflexed arms), ± felty with individual hairs rarely visible, overtopped by few or no larger ones; *on bracts* below very densely covered with subequal fine spreading fascicled hairs and less densely above; *on outer calyx lobes* outside very densely or densely covered with subequal fine spreading fascicled hairs, often with unequally long arms, overtopped by scattered hooked simple hairs, inside more or less densely covered with subequal fine antrorse-spreading multiangulate fascicled hairs on the upper half to two-thirds; *on inner calyx lobes* outside more or less densely covered with subequal fine spreading multiangulate fascicled hairs, inside glabrous. *Leaves* without axillary tuft of hairs; *petiole* (0.8–) 2–5 (–6.3) mm long, often indistinct; *lamina* obovate-oblong, obovate rarely oblanceolate, (5.4–) 15–50 (–81.5) × (6–) 10–20 (–30.6) mm, rounded to truncate with mucronate vein-end, gradually to ± abruptly constricted into petiole, entire to sinuate, ± flat with slightly recurved margins, above more or less grooved along much of the network of veins (usually more than 8 lateral veins) and fascicled-puberulous with deciduous hooked simple hairs along the flanks, below more or less raised but partly visible network of veins and tomentose with uniform hairs, distinctly discolourous; juvenile leaves not seen but adult leaves exhibit vein-ends rarely with shallow serrations mainly distally on the margins. *Flowers* single, "axillary" rarely on visible fascicled short shoots, towards the end of branches, with ellipsoidal buds; *peduncle* stiff, 10.8–24.6 mm long, slightly compressed and ridged; *bracts* narrowly oblong to oblong-spathulate, 3.3–6.2 × 0.6–1.2 mm, ca half to two-third of outer calyx lobes, acute to pointed, erect or erecto to spreading, tomentose. *Calyx* lobes unequal; *outer calyx lobes* (3), lanceolate, 10.8–12.4 × 4.8–6.4 mm, distinctly longer than inner ones, pointed rarely acute, scarcely to more or less ridged, outside fascicled-tomentose with few overtopping hooked simple hairs, inside pubescent on upper half to two-third; *inner calyx lobes* (2) obovate, 9.3–10.6 × 6.3–7.5 mm, blunt to rounded; without ridges, outside tomentose and fascicled-ciliate at the apex, inside glabrous. *Petals* obovate, 8.7–11.4 mm long, shallowly bilobed. *Stamens*

32–48 (without staminodes), unequal with 1–4 longer ones, in 2 or 3 groups around the ovaries; *filaments* strap-like, 1.8–3.9 mm long, scarcely connate basally; *anthers* narrowly obloid, (1.4–) 2.0–2.2 mm, or 2.9–3.55 mm long, more or less straight, abruptly constricted above and more gradually below. *Pistils* 2; *ovary* broadly obovoid, with 4–6 parietal ovules, densely tomentose also on the style base, with style attached laterally then curved out- and upward and again inward to place the constricted stigma above the apex of the anthers. *Fruiting peduncle* scarcely elongating, recurved. *Seeds* obovoid and scarcely laterally compressed, 2.5–2.6 × 2 –2.2 mm, black; aril with fleshy attachment expanding into a cup-like, lobed membrane covering two-third of the seed. *Flowering*: June–September. **Fig. 4G–J**.

Distribution and ecology. Usually associated with ironstone (rarely granite) in open forest to woodland, known mainly from the Iron Range, northern Queensland (Co).

Conservation status. Conserved in the Iron Range National Park, where it was recorded as common (*L.J.Brass 19350*) in 1948.

Diagnostic features. *Hibbertia reticulata* has similar broad leaves to *H. hermanniifolia* and *H. hexandra,* but is distinguished by its reticulate venation on the upper and lower surface as well as hooked simple hairs along the margin, particularly of young leaves. The hairs may appear to be rosette-like fascicled hairs as typical of the §*Tomentosae*, because the bases of the reflexed arms are sometimes bulging excessively. It also resembles *H. melhanioides* but differs by the extensively reticulate venation and hooked simple hairs of mainly young leaves, and essentially by the whole plant being covered with multiangulate fascicled hairs, as compared to rosette-like fascicled hairs in *H. melhanioides* (cf. Toelken 2010a).

Variation. The two or three first leaves of lateral branches are commonly very much smaller (less than half the size) of normal leaves, and therefore rapidly growing branches (e.g. *H.E.Volck AFO 3263*) with long internodes and very large leaves have a very different appearance to senescent branches with smaller leaves of more or less the same size and short internodes (e.g. *B.J.Conn 3787 & A.N.L.Doust* from the same locality, Mt Tozer).

Although usually 6–10 lateral veins are visible, there may be up to 16 on particularly large and well-developed leaves. The shape and size of the bracts also vary considerably.

Etymology. The almost complete "reticulate" venation particularly visible on the adaxial surface, especially of young leaves, is referred to in the Latin epithet "reticulata".

Selection of specimens examined (21 seen)

Queensland: *L.J.Brass 19024*, northern slopes of Mt Tozer, 3.vi.1948 (BRI, CANB); *L.J.Brass 19350,* Tozer Range northern end*,* 29.vi.1948 (BRI); *B.G.Briggs 7331*, 4 km NW Mt Tozer, 21.viii.1983 (NSW); *C.H.Gittens 1074*, Mt Tozer, viii.1965 (NSW); *C.H.Gittens 1086*, Kennedy Road, viii.1968 (NSW); *B.Hyland 7549*, Mt Carter, 15.ix.1974 (QRS); *A.Irvine 258*, Puff de Looney Ridge, 3.vii.1972 (CANB); *A.C.Robinson BRI 194178*, Tozer Gap, 31.x.1974 (BRI); *M.B.Thomas 296*, Tozer Gap, 9.vii.1988 (BRI); *H.E.Volk AFO 2409*; near Mt Tozer, ix.1962 (QRS); *H.E.Volk 3263*, Mt Tozer, viii.1966 (QRS); *L.J.Webb & J.G.Tracey 13487*, northern Mt Tozer, 26.xi.1977 (QRS).

***Hibbertia spathulata* N.A.Wakef.**

Victorian Naturalist 73: 166 (1957); J.H.Willis, Handb. Pl. Victoria 2: 386 (1973); Toelken in N.G.Walsh & Entwisle, Fl. Victoria 3: 304 (1996). — **Typus**: Victoria, Butchers Ridge, Snowy River, *N.A.Wakefield 4832*, 10.ix.1955 (holo.: MEL1010267; iso.: CANB, K, NSW).

Shrubs 0.5–0.8 (–1.5) m tall, with several stems, erect to spreading; branches terete to scarcely flanged from the leaf base, tomentose. *Vestiture*: persistent, dense, with larger with/over smaller erect multiangulate, mainly narrow-based fascicled hairs on most parts of the plant; *on branches* dense, with few larger with thinner erect-spreading narrow-based fascicled hairs (7–12 unequal to subequal arms); *on leaves above* dense with subequal erect to rarely antrorse multiangulate narrow-based fascicled hairs (3–8 (–14) subequal arms), with base cells usually not developed; *on leaves below* very dense, with erect smaller subequal multiangulate, mainly narrow-based fascicled hairs but ± overtopped by, or with few interspersed broad-based ones (7–11 subequal or rarely with the odd longer arms, but often not fully visible because of denseness of hairs) mainly on the central vein and recurved margins; *on bracts* above and below dense, with subequal erect to spreading multiangulate narrow-based fascicled hairs with slightly longer arms along the margin and the central ridge; *on outer calyx lobes* outside very dense, with ± broad-based spreading but short-branched multiangulate fascicled hairs except for a few spreading ones along on the central ridge and the margins, inside with antrorse fascicled hairs on upper half to third; *on inner calyx lobes* outside dense, with ± broad-based cactiform fascicled hairs except for a few spreading ones along the central ridge and with fascicled to simple cilia on the membranous margin, inside glabrous. *Leaves* without axillary tufts of hairs; *petiole* 0–0.5 mm long, indistinct; *lamina* often broadly but also narrowly obtriangular to spathulate, 3.8–22.3 × (1.2–) 1.5–4 (–8.3) mm, truncate with scarcely recurved apex, entire, flat, rarely ± folded lengthwise, above ± grooved along the central vein and tomentose, below with bold central vein usually raised above the recurved margins and tomentose, vaguely discolourous; juvenile leaves not seen. *Flowers* single, terminal, sessile or subsessile, with ovoid to ellipsoidal buds; *peduncle* 0.6–4.4 mm long, terete; *bracts* linear-oblanceolate, (4.5–) 5.0–5.4 × 0.9–1.3 mm, bluntly acute, leaf-like with slightly recurved margins, as long as or just shorter than outer calyx lobes, ridged, tomentose. *Calyx* with lobes scarcely unequal; *outer calyx lobes*

(3) lanceolate, 5.2–5.9× 2.7–3.0 mm, scarcely larger than inner ones, acute, outside ridged or keeled and tomentose, inside pubescent to tomentose on often more than the upper half; *inner calyx lobes* (2) ovate, 5.0–5.3 × 3.1–4.0 mm, obtuse to cuspidate, without ridge, outside finely tomentose to almost stubble-like and with fascicled cilia on membranous margin, inside glabrous. *Petals* oblong-oblanceolate, 5.8–7.8 × 3.5–5.5 mm, scarcely bilobed. *Stamens* 5–12 (plus 2–8 staminodes), unequal, in 5 bundles around the ovaries; filament filamentous, 0.8–1.1 mm long, scarcely connate basally; anthers narrowly obloid, 0.9–1.3 mm long, or 1-3 longer ones (1.6–1.8 mm long) in centre surrounded by shorter ones, abruptly constricted above and below, straight. *Pistils* 2; *ovaries* obovoid, each with 2 (–4) ovules (usually 2 basal ones or rarely in pairs above one another), tomentose, with style attached to dorsal apex then erect to position stigmas laterally to upper part of longer anther/s. *Fruiting peduncle* scarcely elongating, recurved. *Seeds* not seen.

Diagnostic features. A similar tomentum of dense fascicled hairs (rarely with a few broad-based ones) on the upper and lower leaf surfaces, and the absence of stalked fascicled hairs on the leaves and branches, as well as the usually subsessile flowers, distinguish this species from *H. hermanniifolia*. Altogether the leaves as well as the hairs are much thinner in this species, and are similar to those of *H. acaulothrix*. The latter has commonly elongated leaves, and the fascicled hairs on the upper leaf surface have only 1–3 arms, while the arms of the larger hairs, mainly on the flanks or at least on the lower cuneate base, are 2–4 times longer than those of the smaller hairs next to them. Bracts are also longer than the sepals and large obovate petals are also distinctive for *H. acaulothrix*.

Key to subspecies

1. Shrubs with many wiry-woody branchlets (often twiggy); hairs on upper leaf surface with up to (3–) 5 or 6 (–8) arms . . . . . subsp. ***spathulata***

1: Shrubs with rigid-woody branches, hairs on upper leaf surface with up to 8–10 (–14) arms . . subsp. ***pleioclada***

***Hibbertia spathulata* subsp. *spathulata*.**

Shrub much branched, often twiggy, usually with wiry branches. *Leaves* (3.8–) 4.5–8.5 (–13.6) × (1.2–) 1.5–4 (–5.4) mm, on upper surface with subequal hairs each with (3–) 5 or 6 (–8) arms. *Outer calyx lobes* outside mainly densely covered with cactiform fascicled hairs or with very short arms and usually broad-based; all these overtopped by larger coarse hairs. *Flowering*: September–December. **Fig. 3E–G**.

Distribution and ecology. Recorded from rocky slopes in open heath, woodland or sclerophyll forest in the catchment of the Snowy River, Victoria (EG).

Conservation status. Notes on herbarium specimens give no indication of the size of recorded populations. It was last collected in 1988.

Variation. Since only a few records of this species are available, not much is known about its variation. One collection (*R.D.Hoogland 11922*) has slender elongate leaves, but unlike those of *H. acaulothrix*, they are only up to 3 mm broad. The peduncles of some of the flowers of this collection are up to 5 mm long.

The difference between the closely resembling *H. spathulata* and *H. hermanniifolia* subsp. *recondita*, which also occur close to one another, is not merely based on the absence or presence of stalked fascicled hairs but also on a similar dense fascicled tomentum of both leaf surfaces of *H. spathulata*, whereas *H. hermanniifolia* subsp. *recondita* has fewer hairs with few arms adaxially.

Specimens examined

Victoria: *A.C.Beauglehole 37356*, Museum Spur, 11.iii.1973 (CANB, MEL); *S.J.Forbes 171*, SE Campbells Knob, 12 ix.1979 (MEL ×2); *R.D.Hoogland 11922*, ca 5 miles [8 km] ESE Suggan Buggan, 29.xii.1970 (MEL, NSW); *N.G.Walsh 2209 & K.C.Norris*, Museum Spur, 15.xi.1988 (CANB, MEL).

Hibbertia spathulata* subsp. *pleioclada* Toelken, *subsp. nov.

A subspecie typica et a H. hermanniifolia *subsp.* recondita *foliis majoribus et ramis pluribus pilorum in paginis superis differt.*

Typus: New South Wales, Mt Jondol, 25 km SE Tenterfield, *J.T.Hunter 3197*, 1.vi.1995 (holo.: AD; iso.: NE, NSW – n.v.).

Shrub moderately branched, with rigid-woody branches. *Leaves* (5.8–) 7.0–18.0 (–22.3) × (2.4–) 3.5–5.0 (–8.3) mm, on upper surface with subequal hairs each with 8–10 (–14) arms. *Outer calyx lobes* outside mainly densely covered with subequal fascicled hairs with fine arms and usually small-based, except for larger fine overtopping hairs. *Flowering*: June.

Distribution and ecology. Grows on sandy soil on west aspect of granite outcrop in dry heath vegetation in northern New South Wales (NT).

Conservation status. Recorded as locally common in Forestlands State Forest (*J.T.Hunter 3197*), but only collected once in 1995.

Variation. The only two branches of this subspecies examined indicate a much more robust plant than typical *H. spathulata,* not only because of the woody stems, but also since the leaves on the main branch are up to 22.3 mm long, while in the typical subspecies they are rarely up to 13.6 mm long. There are, however, a few leaves on the type specimen of this subspecies that show some overlap with the size of leaves of the typical plants, so that only subspecific status is applied until more specimens will reveal a fuller range of variation of this taxon.

The many arms of the fascicled hairs of the upper leaf surface distinguish this subspecies from specimens of *H. hermanniifolia* subsp. *recondita*, which is mainly

recognised by its short-stalked fascicled hairs on the lower surface of their leaves. Both of them occur on the Northern Tableland. The dense hairs and the larger number of arms of these hairs are approaching those on the undersurface and the rest of the plant and are possibly closer to those of seedlings of these plants (cf. seedlings in Toelken 2010a).

Etymology. The epithet "pleio-clada", Latinised Greek, "more (than usual)-branched" refers to the larger number of arms of the fascicled hairs on upper leaf surface.

Specimen examined.

Known only from the type collection.

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Notes on *Hibbertia* (Dilleniaceae) 8. Seven new species, a new combination and four new subspecies from subgen. *Hemistemma*, mainly from the central coast of New South Wales

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Abstract

Increased collections from the *Hibbertia*-rich vicinity of Sydney, New South Wales, prompted a survey of rarer species to publicise the need for more information ahead of the rapid urban spread. Many of these species were previously misunderstood or are listed as rare and endangered.

Thirteen new taxa (in bold) are described and discussed in context with the following seventeen taxa within seven different species groups: 1. *H. acicularis* group: ***H. woronorana*** Toelken; 2. *H. humifusa* group: ***H. fumana*** Toelken; 3. *H. pedunculata* group: ***H. intermedia*** (DC.) Toelken; 4. *H. rufa* group: ***H. pilifera*** Toelken, ***H. pustulata*** Toelken, *H. rufa* N.A.Wakef., ***H. surcularis*** Toelken; 5. *H. sericea* group: *H. puberula* subsp. *puberula*, – subsp. ***extensa*** R.T.Mill. and – subsp. ***glabrescens*** Toelken; 6. *H. stricta* group: *H. cistiflora* N.A.Wakef. subsp. *cistiflora*, – subsp. ***quadristaminea*** Toelken, ***H. oxycraspedota*** Toelken & R.T.Mill., *H. stricta* (R.Br. ex DC.) F.Muell. subsp. *stricta*, – subsp. ***furcatula*** Toelken, ***H. sulcinervis*** Toelken; 7. H. strigosa group: ***H. strigosa*** Toelken.

Keywords: Dilleniaceae, *Hibbertia*, nomenclature, revision, taxonomy, eastern Australia.

Introduction

Bentham's treatment of *Hibbertia* for *Flora Australiensis* in 1863 cannot provide adequate answers for the many collections accumulated since. Collectors are now also more aware of varying forms in different environments and this is apparent from many newer collections. Some of these distinct taxa had already been recognised by N.A. Wakefield in Victoria and R.D. Hoogland generally in Australia, but only fragments of this information have been published due to their untimely deaths.

It would be preferrable to revise the genus in individual species groups in order to achieve a more coherent phylogenetic approach, but increasing demand for names and identification tools of *Hibbertia*, especially near fast developing cities such as Sydney, drives this paper. A number of old and recently collected species were selected for this publication to show that inadequate knowledge of the taxonomy of species of *Hibbertia* is widespread in most groups of the genus, even in, for instance, this botanically well-known region, where most of the early exploration started.

Old names and new taxa are both considered alike. The two species *H. fumana* and *H. intermedia*, which are based on specimens collected about two hundred years ago, deserve fuller recognition and, in the case of *H. fumana,* this paper hopefully will help to rediscover plants in the wild, as the species has not been recorded since Sieber's collection in 1820s.

The paper also explores the morphological variation in *Hibbertia* of the Sydney region in order to demonstrate how many forms, at present relegated to variations of previously described species, can clearly be delineated and segregated, often as infraspecific taxa. Usually only one species per group was considered (Tab. 1), except where a wider sample was needed to present the new taxa in their wider context, as in the case of the *H. puberula*, *H. rufa* and *H. stricta* groups. A number of species-groups are also here introduced to create awareness of possible subdivisions of, for instance, Bentham's *H. stricta* supercomplex that was (and is) still maintained by subsequent authors. They allow a provisional structuring of the species into groups (Tab. 1), although these groups still require more ongoing research into the eastern Australian species of *Hibbertia*.

Some of the new species are, however, described on the basis of very few specimens and more information of their distribution and range of variation would greatly assist to better understand and clearer delimit these taxa, i.e. species limits might need further adjusting as well, as more material and information becomes available.

A good example of this is the new extensive treatment of the *H. puberula* complex, which was previously described on the basis of few specimens (Toelken 2000). It seemed for a time that the species complex was possibly extinct, because no more plants could be found at known localities. Not only has its taxonomy changed to include two subspecies, but its range has been extended from an apparently coastal species of Sydney to inland localities from Wollemi to Morton National Parks. Numerous specimens of this species are purposely cited here, not only to underpin the taxonomy and increased knowledge of the species, but also to demonstrate the importance of small parks and reserves as refuges for native species in a time of rapid urban spread. Nobody knew that the plants occurred there and only interested volunteers, who have changed and are constantly further changing our knowledge of their variation and distribution, have made it possible that the taxonomy of the *H puberula* complex is presented in this paper.

In order to put these often rare species into perspective with known species or species-groups a few taxa were included, which do not occur in the immediate vicinity of Sydney. It is thus hoped that this paper will generally encourage more discerning collecting of *Hibbertia* specimens everywhere.

The species-groups, species and subspecies are all alphabetically arranged. The terminology is similar to that used in previous publications and described in detail in Toelken (2010b). This paper is based on herbarium material. Funds for detailed field work were not available. The conservation status of these taxa will require further assessment. For information purposes and to aid this assessment, the frequency as reported by collectors is provided after the descriptions.

1. *H. acicularis* (Labill.) F.Muell. group

This species-group is characterized by awned leaves and stalked flowers; its species occur in a wide range of habitats of eastern Australia from Queensland to Tasmania. There are about 18 species in the group and some are extremely localised endemics. They are often restricted to a mountain range or even a single mountain in an 'inselberg' distribution on the eastern and western slopes of the Great Divide. *Hibbertia woronorana* is, for instance, localized to the Woronora River, south of Sydney.

The position of the bract along the flower stalk varies between and within species, so that it cannot be compared to the peduncle in the *H. cistoidea* (Hook.) C.T.White group (Toelken, in prep.), as the flower stalk consists of the penultimate and ultimate internodes (cf. *H. australis* N.A.Wakef. group, in Toelken 2010b). However, in view of the variation of the position of the primary bract, it proved convenient to use measurements of the whole flower stalk (cf. *H. rufa* N.A.Wakef. group, below).

Hibbertia woronorana* Toelken, *sp. nov.

Hibbertiae aciculari *(Labill.) F.Muell. similis sed ramis foliis et calicibus glabris, foliis patentibus brevioribus (5.3–11.3 mm longis), calicibus brevioribus (3.7–4.3 mm longis) differt.*

Typus: New South Wales: Woronora River at Heathcote Bridge, *R.D.Hoogland 12257* (holo.: MEL; iso.: CANB, K, L, NSW, US – *n.v.*).

H. acicularis auct. non (Labill.) F.Muell.: A.A.Hamilton, Proc. Linn. Soc. New South Wales 40: 628 (1915), as per specimens from Woronora River.

Much-branched shrublets up to 1 m tall, with stiff-woody main branches and stems; distal branches wiry and with decurrent leaf bases, purplish-red, glabrous. *Vestiture* absent except for short tufts in leaf axils and short erect to antrorse simple hairs on the ovary. *Leaves* without or with sparse short axillary (intrapetiolar) tuft of hairs (up to 0.15 mm long) usually hidden by appressed petiole; *petiole* 0.2–0.5 (–0.7) mm long, ± dorsiventrally compressed; *lamina* linear-lanceolate to linear when revolute margins are strongly recurved, (5.3–) 7.0–9.0 (–11.3) × (0.45–) 0.6–0.7 (–0.85) mm, with apex drawn into terminal bristle 0.2–0.6 (–0.85) mm long, abruptly constricted into petiole, above ± flat, below with strongly revolute margins and broader, usually deeply recessed, central vein but the undersurface not visible between them, spreading, often at right angles to stems, glabrous. *Flowers* single, terminal, becoming ± leaf-opposed mainly along main shoots; flower stalk thread-like, (8.8–) 11–13 (–14.7) mm long, with bract on upper third, recurved in bud and in fruit; *buds* narrowly ovoid; *bracts* linear, rarely linear-triangular, 0.6–0.8 (–1.1) × 0.1–0.2 mm, acute or with short bristle, with central vein scarcely visible, glabrous. *Calyx* scarcely accrescent; *outer calyx lobes* narrowly oblong to oblong-elliptic, (3.8–) 4.0–4.3 × 1.2–1.5 mm, rarely slightly shorter than inner ones, acute, without central ridge, glabrous; *inner calyx lobes* oblong-ovate to oblong-elliptic, (3.7–) 4.0–4.3 × 2.2–2.7 mm, abruptly constricted into shortly acute apex, without central ridge, glabrous. *Petals* oblanceolate to oblong-oblanceolate, (3.3–) 3.9–5.0 (–5.4) mm long, emarginate, rarely bilobed. *Stamens* (4) 5 or 6*; filaments* 1.0–1.2 mm long, up to lower third connate; *anthers* narrowly obloid, 1.25–1.4 mm long, abruptly constricted above and below. *Pistils* 2; *ovary* obovoid, tomentose to pubescent, with 2 (–4) ovules, scarcely laterally compressed with style attached to upper edge next to stamens, then straight erect upwards on either side of stamen cluster placing the fine stigma well above the apex of the anthers. *Fruit* usually puberulous. *Seed* unknown. *Flowering:* September–December. **Fig. 1A–C.**

Distribution and ecology. Restricted to the mid and lower reaches of the Woronora River, New South Wales (CC). Growing on rocky sandstone slopes in sclerophyll forest comprised of *Angophora costata, Corymbia gummifera, Eucalyptus punctata* and stringybark sp. in association with *Allocasuarina littoralis, Doryanthes*

excelsa, Banksia serrata, Dodonaea triquetra, Platysace linearifolia, Epacris pulchella, Hakea dactyloides, Grevillea buxifolia, Grevillea diffusa, Acacia linifolia, Xanthosia tridentifera; in the Dingo Tunnel vicinity and fluvial deposits such as deep sandy bars with *Angophora costata, Corymbia gummifera, Eucalyptus punctata* on slopes and in association with *Stenocarpus salignus, Grevillea longifolia, Hakea dactyloides, Persoonia levis, Stylidium laricifolium, Dodonaea triquetra, Grevillea diffusa, Doryanthes excelsa, Platysace linearifolia, Pultenaea flexilis, Grevillea mucronulata, Lepidosperma laterale, Dampiera purpurea, D. stricta, Astroloma pinifolius, Xanthosia pilosa, X. tridentifera, Hypolaena fastigata* in the Broula Pool vicinity and infrequently sandy loam soils of levee banks.

Conservation status. Highly restricted small localised populations within Heathcote National Park though locally common at some sites (*R.T.Miller & J.Miller 69/18.iii.2007*). Extremely vulnerable to disturbances, rare and possibly endangered downstream of the Needles (*R.T.Miller & J.Miller 11/1.xi.2008*). It could not be relocated in the Como vicinity (R.T. Miller, pers. obs.).

Diagnostic features. *Hibbertia woronorana* is superficially very similar to *H. acicularis*, but the whole plant, including the calyx, is glabrous. The shorter leaves are spreading at about right angles to the branches, the calyx is only 3.7–4.3 mm long and anthers are 1.25–1.4 mm long.

Variation. The bract does not subtend the calyx, but is usually found in the upper third of the flower stalk. Its position on the stalk varies considerably, even sometimes on the same plant.

Although the filaments are usually connate in the lower third, some were observed to be fused up to two-thirds on some plants. Since this species has 4–6 stamens of subequal length, it seems likely that *H. woronorana* has the same pollination syndrome as the *H. rufa* group (see below). The two species groups are, however, not considered to be closely related, as the non-acicular leaves and the compressed ovaries with laterally attached styles of *H. rufa* clearly show.

Etymology. As the species mainly occurs along the Woronora River the suffix '-ana', Latin, was added to indicate 'position or possession'.

Specimens examined

New South Wales. **CC:** *E.Betche NSW 102275,* Woronora River near Como on sandbanks, xii.1893 (NSW); *E.Cheel NSW 102273,* Woronora River, 2.x.1901 (NSW); *A.A.Hamilton NSW 102274,* Heathcote, Woronora River, x.1915 (NSW); *R.D.Hoogland 12257,* at Heathcote Bridge, 13.ix.1972 (MEL); *R.T.Miller & J.Miller 69/18.iii.2007*, Water Board track above Woronora River (AD, NSW); *R.T.Miller & J.Miller 11/1.xi.2008*, Woronora River between Forbes Creek and the Needles (AD).

2. *H. humifusa* F.Muell. group

Although species of this group have dense fascicled hairs and especially pronounced intrapetiolar tufts of hair, similar to those of the *H. sericea* group (Toelken 2000: 7), they are distinguished by their more or less stalked flowers not aggregated into inflorescences and decumbent to prostrate growth habit. Unlike the superficially similar species of the *H. pedunculata* group (cf. below), *H. fumana* has stamens in a cluster on one side of the ovaries and the whole plant is fascicled-pubescent to tomentose. Toelken (1995) taxonomically re-assessed *H. humifusa* and its three subspecies, which occur in widely separated populations in Victoria.

Hibbertia fumana* Sieber ex Toelken, *sp. nov.

A H. humifusa *F.Muell. foliis brevioribus (1.9–) 2.1–3.1 (–3.3) mm longis, paginis abaxillaribus foliorum non visibilibus ramisque sine pilis simplicibus differt.*
Typus: Australia, near Sydney, "*F.W.Sieber Nov. Holl. No. 147*" (holo.: MEL 31618; iso.: K; NY – n.v.)

Pleurandra fumana Sieber ex Benth., Fl. Austral. 1: 27 (1863), nom. inval., pro syn.

Hibbertia stricta var. *glabriuscula* Benth. Fl. Austral. 1: 27 (1863), partly as for *Sieber 147.*

Decumbent shrublet, prostrate, with many branches from the base, moderately to much branched; branches, wiry, with raised leaf bases shortly decurrent, shortly fascicled-pubescent. *Vestiture* persistent, consisting of more or less coarse simple hairs over fine fascicled hairs on tubercles; *on branches* more or less densely covered with short subequal multiangulate fascicled hairs (4–7 equal arms) and without simple hairs except for intrapetiolar tufts of hairs in leaf axils; *on leaves above* scattered, short antrorse fine bi- or triforked to simple hairs, sparse becoming denser onto the petiole, few simple hairs along the flanks, all wearing off soon; *on leaves below* dense, with short subequal multiangulate fascicled hairs (4–12 subequal arms) particularly on central vein, overtopped by few simple hairs on the flanks of the revolute margins; *on outer calyx* moderately outside dense, with spreading coarse antrorse simple hairs over erect-spreading multiangulate fascicled hairs (8–15 subequal arms), inside dense, with forked to simple antrorse hairs over most of surface; *on inner calyx lobes* outside dense with spreading multiangular fascicled hairs (2–12 subequal or unequal arms) becoming smaller towards the membranous margins, overtopped by coarse antrorse simple hairs along the central ridge, inside glabrous except for a few simple hairs towards the apex. *Leaves* with intrapetiolar axillary tuft of hairs up to 0.7 mm long; *petiole* 0.2–0.45 mm long; *lamina* narrowly oblong, rarely linear-elliptic, (1.9–) 2.1–3.1 (–3.3) × 0.5–0.8 mm, obtuse, with terminal tuft on a somewhat recurved apex of the central vein, more or less abruptly constricted into petiole, above ± flat and puberulous to glabrescent, below with broadened central vein recessed below the level of revolute margins and protruding into apex, pubescent to puberulous. *Flowers* single, terminal, commonly on main branches; *flower stalk* 2–8 mm long,

recurved and elongating after flowering; *bract* linear to linear-triangular, 1–1.3 mm long, fascicled-pubescent, on lower third of flower stalk. *Calyx* distinctly accrescent, with lobes subequally long; *outer calyx lobes* lanceolate, 4.5–5.7 × 1.3–1.65 mm, acute to acuminate, without ridge, outside strigose-pubescent, inside finely strigose with antrorse forked hairs on much of the surface; *inner calyx lobes* oblong-ovate, 4.5–5.8 × 3.1–3.5 mm, usually cuspidate, outside strigose along the central vein and tomentose towards the margins, inside glabrous with few forked hairs at the apex. *Petals* obovate, 4–5.2 mm long, broadly bilobed. *Stamens* 5 or 6 (7), subequal, clustered on one side of the ovaries; *filaments* 0.4–0.6 mm long, basally connate; *anthers* broadly oblong, 1.3–1.4 mm long, ± abruptly constricted above and below. *Pistils* 2; *ovaries* obovoid but ± laterally compressed, each with 4 ovules, fascicled-tomentose, with style attached to dorsal apex then base recurved to the base and up on either side of the stamens with stigmas exposed above the anthers. *Fruit* and *seeds* unknown. *Flowering*: August. **Fig. 1D.**

Distribution and ecology. Without precise locality or ecological data from "near South Heads", Sydney, New South Wales.

Conservation status. Presumed extinct. Known only from a few collections made near Sydney before 1824.

Diagnostic features. *H. fumana* has a very similar vestiture, leaves and stalked flowers to *H. humifusa* from Victoria, but differs from the latter by much smaller leaves and the lack of simple hairs along the branches, except for the tufts of hairs in the leaf axils.

Note. Although no collecting dates are available for the few specimens of this species, it would seem that G. Caley is the discoverer of this plant, as there is a specimen of his in BM, accompanied by a small collector's tag inscribed "Aug. 02 near South Heads". While Robert Brown's collection "In occidental Sydney 1804" does not provide a definite locality, it is broadly consistent with that of Caley. The Brown specimen was subsequently incorrectly identified as *Pleurandra hirsuta* Hook. (1836) (= *Hibbertia hirsuta* (Hook.) Benth.) based on its superficial resemblance, but is distinguished from this species by its vestiture and presence of a flower stalk and 5–7 stamens.

Etymology. Sieber's suggested name for the plant on the collector's label was retained as it draws attention to the similarity of the linear hairy leaves to those of the species of the genus *Fumana* (Cistaceae).

Specimens examined

New South Wales. **CC:** *R.Brown* [*J.J.Bennett 4873*], "In occidental Sydney 1804" (BM); *G.Caley s.n.*, "near South Head", viii.1802 (BM).

3. *H. pedunculata* R.Br. ex DC. group

Bentham (1863) included the *H. pedunculata* species-group (characterized by their stalked flowers), together with the sessile-flowered *H. serpyllifolia* R.Br. ex. DC. and *H. vestita* A.Cunn. ex Benth. groups, in §*Vestitae* Benth. In spite of stamens being arranged around the ovary in these three groups, they are included in subgen. *Hemistemma* (Horn 2004, 2009); other species of the subgenus have a cluster of stamens to one side of the ovary. Most species of the *H. pedunculata* group have fascicled and simple hairs, more or less pronounced intrapetiolar axillary tufts of hairs, and the wiry branches usually have a prostrate to decumbent habit. They are recorded — some of the species from all too few specimens — from often widely disjunct localities along the Great Divide from northern New South Wales to central Victoria.

Hibbertia intermedia* (DC.) Toelken, *comb. nov.

Pleurandra intermedia DC., Regn. Veg. Syst. Nat.. 1: 420 (1817); Prodr. 1: 72 (1824); Spreng., Syst. Veg. edn 16, 2: 462 (1825); G.Don, Gen. Hist. 1: 64 (1842). — **Type citation:** "in montibus Novae-Hollandiae. Caley" (holo.: G-DC).

Hibbertia pedunculata auctt. non R.Br. ex DC.: Benth., Fl. Austral. 1: 32 (1863), p.p.; F.Muell., Key Syst. Vict. Pl. 2: *5* (1885), p.p.; Second. Syst. Cens. 1: 2 (1889), p.p.; Ewart, Fl. Vict. 767 (1930), partly; J.H.Willis, Handb. Pl. Vict. 2: 386 (1973), p.p.; G.J.Harden & J.Everett in G.J.Harden, Fl. New South Wales 1: 300 (1990), p.p.; Toelken in Walsh & Entwisle, Fl. Vict. 3:304 (1996), p.p.

Shrublets rarely higher than 15 cm, with prostrate or procumbent branches up to 25 cm long; branches wiry, with raised leaf bases decurrent and ± flanged, pubescent to glabrescent. *Vestiture* ± persistent, dense to sparse with mixed longer and shorter mainly simple hairs (rarely biforked) often on distinct tubercles; *on branches* moderately dense to denser between flanges, with mainly long ones over few shorter antrorse simple hairs with basal tubercle; *on leaves above* not persistent, with scattered antrorse, ± appressed short hairs (subequal) on tubercles, particularly on the flanks of revolute margins; *on leaves below* not persistent, with very few hairs similar to upper surface, very rare on central vein, except for persistent terminal tuft; *on bracts* as on leaves but often more spreading; *on outer calyx lobes* outside glabrous or with scattered short hairs without tubercles, mainly on terminal central ridge, inside glabrous, rarely with few scattered hairs towards the apex; *on inner calyx lobes* outside glabrous to very fine hairs on distal central area, inside glabrous. *Leaves* with sparse axillary tufts up to 0.6 mm long and usually continued along both sides of the petiole of leaves, mainly below flowers; *petiole* 0.2–0.7 mm long; *lamina* linear to narrowly oblong, (1.8–) 2.3–3.0 (–4.6) × (0.45–) 0.6–0.8 (–1.1) mm, gradually constricted into the petiole, acute, but with terminal tuft of hairs wearing off and becoming obtuse, above flat, puberulous, soon glabrescent, with tubercles usually recessed, below similarly glabrescent or with papillae on the exposed undersurface between the broad central vein and revolute margins. *Flowers* single, terminal on main and lateral

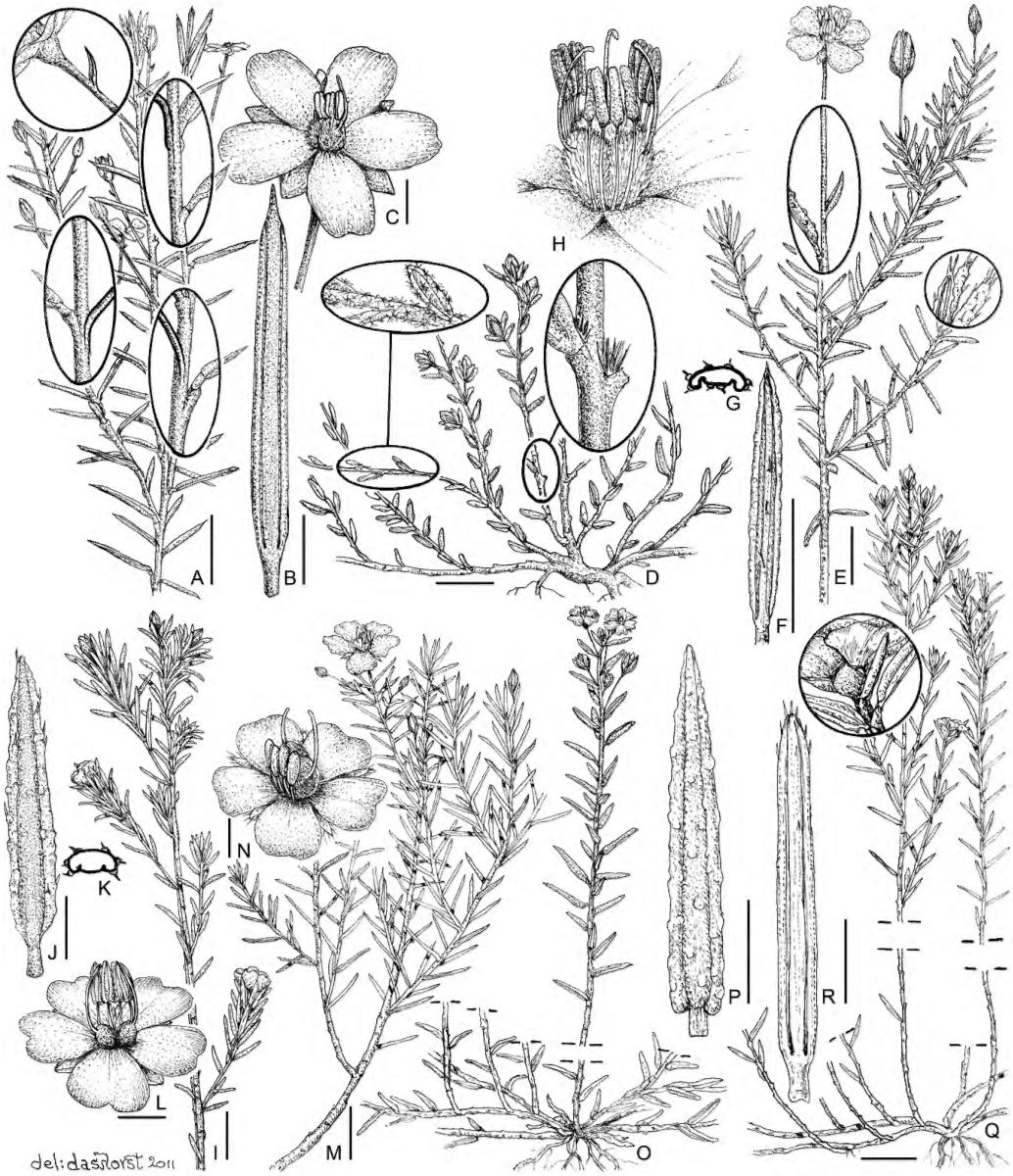

Fig. 1. A–C *Hibbertia woronorana*: **A** flowering branch; **B** leaf from below; **C** flower. **D *H. fumana***: flowering plant. **E–H *H. intermedia***: **E** flowering branch; **F** leaf from below; **G** transverse section through mid-leaf; **H** flower with petals removed. **I–L *H. pustulata***: **I** flowering branch; **J** leaf from below, **K** transverse section through mid-leaf; **L** flower. **M**, **N *H. pilifera***: **M**, flowering branch; **N**, flower. **O**, **P *H. rufa***: **O** flowering plant; **P** leaf from below. **Q**, **R *H. surcularis***: **Q** flowering plant; **R** leaf from below. Scale bars: habits (**A**, **D**, **E**, **I**, **M**, **O**, **Q**) 10 mm; leaves (**B**, **F**, **J**, **P**, **R**) 2 mm; flowers (**C**, **L**, **N**) 2.5 mm. — **A–C** *R.T. & J.Miller 69/18.iii.2007*; **D** *F.W.Sieber 147* (MEL 311616); **E–H** *R.T & J.Miller 73/8.iii.2007*; **I–L** *S.Bell 216*; **M, N** *S.Bell 20*; **O, P** *R.Bates 10812*; **Q, R** *H.R.Toelken 7979*.

Table 1. Characters of species in *H. rufa* species-group.

Character	*H. surcularis*	*H. pustulata*	*H. pilifera*	*H. rufa*
Habit	erect-spreading	decumbent	spreading to decumbent	prostrate or scrambling
Leaves	cuneate base; glabrous	cuneate base; puberulous to denticulate	cuneate base; sparsely sericeous	cordate to truncate base; glabrous (pubescent)
Inflorescence	monads	monads	monads	thyrses, rarely thyrsoids
Flowers	sessile	sessile	stalked	stalked
Bracts	linear-triangular, glabrous	triangular, ciliate	linear-triangular, glabrous	linear, triangular, glabrous (pubescent)
Stamens	4	4	3–5	(3) 4
Filaments	¾ connate	¼ connate	¾ connate	¾ connate

branches, rarely on short shoots, with narrow base or stepped into stalk; flower stalk (as anthopodium) 2–5 mm long, with bract ± at base; *bracts* 1 or 2 (3), linear or linear-triangular, 1.8–2.8 × 0.1–0.2 mm, with scarcely recurved margins, almost membranous, often shortly ciliate, grading into leaves. *Calyx lobes* unequal; *outer calyx lobes* narrowly elliptic, elliptic-lanceolate, 4.5–5.1 × 1.9–2.2 mm, acute, with central ridge more or less developed, puberulous to glabrescent outside, glabrous or sometimes with few hairs on the inside; *inner calyx lobes* elliptic-obovate, 4.4–4.85 × 3.1–3.4 mm, rounded to mucronate, papillate to glabrous. *Petals* obovate, up to 6.8 mm long, bilobed. *Stamens* 7–9 (10) and without staminodes; filaments 1.6–1.8 mm long; *anthers* obloid to broadly obloid, 1.6–1.9 mm long, abruptly constricted above and below, smooth or almost so. *Pistils* 3, 4 (5); ovaries obovoid, hirsute with simple hairs, with 2–4 ovules; *style* attached to the somewhat flatted apex then recurved and upwards to place the incurved stigmas just above the apex of the anthers. *Fruit* and *seeds* not seen. *Flowering*: November–March. **Fig. 1E–H.**

Distribution and ecology. Grows on sandstone formations, usually on wet slopes in low heath, scrub or open woodland in New South Wales (CT, CC). Observed at one locality only within the riparian zone of the Grose River growing atop large flat-toped sandstone boulders and rooting at some nodes (*R.T. & J.Miller 73*).

Conservation status. Not common, but occurs mainly in conserved areas.

Diagnostic features. Since Bentham (1863) everyone always included *H. intermedia* under *H. pedunculata*, but it is more than a glabrous form of that species. It is distinguished from the latter by glabrous or glabrescent calyx lobes, the outer of which are acute and more or less ridged, and the bract is born at the base of the peduncle, while it subtends the flower in *H. pedunculata*.

Variation. Some variation in the leaf shape and especially in the size of the undersurface has been recorded. A few collections from the Maroka Range (Victoria) are very distinct and it is not clear, whether these should also be included in *H. intermedia.* They are at present mainly distinguished by their obtuse leaves with the undersurface not visible between the central vein and revolute margins, and a greater number of stamens.

Notes. *Hibbertia empetrifolia* is superficially similar in the shape of the leaves and the scattered simple hairs, but it has stamens only on one side of the ovaries. This must have confused Candolle (1817) because he inferred that *H. intermedia* is not only 'intermediate' between his *Pleurandra empetrifolia* and *P. ericifolia*, but also between the genera *Pleurandra* and *Hibbertia.* However, the type specimen at G-DC leaves no doubt about the identity of the taxon. *Hibbertia intermedia* is distinct from both those species and also from *H. pedunculata*.

Specimens examined

New South Wales. **CT:** *E.F.Constable NSW 85844*, Blackheath, 17.xi.1946 (NSW); *A.A.Hamilton NSW 85843*, Blackheath, xi.1914 (NSW); *A.A.Hamilton NSW 85856*, Leura, 23.xi.1912 (NSW); *C.L.Wilson 502*, Kings Tableland, 25.iii.1957 (NSW 85853/4). **CC:** *R.T. & J.Miller 73*, Grose River junction with Burralow Creek, 8.iii.2007 (AD, NSW).

4. *H. rufa* N.A.Wakef. group

The *H. rufa* species-group, which is known from mainly the eastern side of the Great Divide, namely from northern New South Wales (NT) to Tasmania, also includes the following three new similar species: *H. pustulata, H. pilifera* and *H. surcularis*. The group is characterized by the combination of usually four stamens and their filaments are more or less, but usually almost entirely connate to form a column (except in *H. pustulata*) at the back of the two glabrous and laterally compressed ovaries, which have the styles dorso-laterally attached. The arrangement of the flower parts indicates a similar pollination syndrome in the four species. The bracts of *H. pustulata* are triangular and membranous, a characteristic of *H. exutiacies* N.A.Wakef. (Toelken in prep.). The latter species has, however, broad, not compressed ovaries with the style attached to their apex.

The four species of the *H. rufa* species-group are found in at least temporarily wet places, swamps or seepage areas. Individual plants often cover large areas, as a more or less branched rhizome spreads continuously above or usually below soil level. The combination of characters that distinguish the individual species are listed in Table 1.

The position of the flowers is of particular interest among the species as it varies from sessile and terminal as monads on main branches in *H. surcularis* and *H. pustulata*, to monads with stalked flowers on lateral branches in *H. pilifera*, and stalked flowers on fascicled lateral branches with bract-like leaves (≠ additional bracts), thus forming distal thyrses (rarely thyrsoids), on all branches of *H. rufa.* The flower stalk of *H. pilifera* consists of two internodes (cf. *H. acicularis* and *H. cistoidea* groups earlier) and is therefore not comparable to the peduncle of the *H. tomentosa* group (Toelken 2010a), where the bract subtends the calyx. In *H. rufa* the bract is similar to or rarely grades into several bract-like leaves of the subtending short shoot, so that it becomes necessary to distinguish between the primary bract and additional bracts. In this species the flower stalk usually consists of only the ultimate internode, the pedicel.

Many specimens of *H. rufa* have been examined, but little is known about the variation and distribution of the other three species. Since they occur in similar habitats, it would be interesting to know whether these three species are always allopatric and, if so, what their specific ecological requirements are.

Key to the species of the *H. rufa* group

1. Flowers clustered distally, each at consecutive nodes and/or if single (rare) then terminal on an axillary short shoot with bract-like leaves; base of leaf lamina truncate to cordate . . . . . ***H. rufa***

1: Flowers single, distally on leafy branches (not at consecutive nodes if more than one); base of leaf lamina cuneate

2. Leaves pustulate abaxially; filaments basally connate . . . . . ***H. pustulata***

2: Leaves smooth or slightly hairy abaxially but without raised bases; filaments mostly connate

3. Flowers stalked; leaves and calyx with appressed hairs . . . . . ***H. pilifera***

3: Flowers sessile; leaves and calyx glabrous except for minute terminal tuft of hairs . . . . . ***H. surcularis***

Hibbertia pilifera* Toelken, *sp. nov.

A H. rufa *habitu plerumque multo ramoso subterraneo et aerio, ramis et calicibus pilis, basibus laminis foliorum cuneatis et plerumque 5 staminibus; a* H. surculari *ramis et calicibus pius, lobis calicis sine costis ad apicem, plerumque 5 staminibus floribusque distincte pedunculatis differt.*

Typus: New South Wales, Adams Lookout, Bungonia Gorge, *M.Evans 2519,* 10.xi.1966 (holo.: CANB 161485; iso.: CANB 161484; A, K, L, NSW – *n.v.*).

Spreading shrublets 0.15 m tall, tufted to becoming decumbent, usually ± branched above and below soil level, repeatedly rooting; branches wiry with long decurrent leaf bases, tinged pink, sparsely short-sericeous to glabrescent. *Vestiture* rarely persisting for a long time, on distal branches and calyx, with simple hairs antrorse, appressed on branches, leaves especially on the undersurface, and on the calyx. *Leaves* with or without short tufts of hairs (up to 0.2 mm long) in the leaf axils but usually hidden by appressed petiole; *petiole* 1.5–3.0 (–3.5) mm long, dorsiventrally compressed; *lamina* linear, narrowly oblong-elliptic to -lanceolate, (4.6–) 5.0–7.5 (–8.8) × 5.4–6.5 (–7.2) mm, with apex drawn into a 0.1–0.25 mm long bristle, but this terminal hair wears off soon, ± gradually constricted into petiole, above ± flat, glabrous to glabrescent along flanks, below with narrow but strongly revolute margins (glabrescent) and more than twice broader central vein (glabrous), but with no undersurface visible except for a row of papillae along the slit. *Flowers* single, terminal, becoming leaf-opposed along upper main branches; *flower stalk* thread-like, (4.2–) 5.0–8.0 (–10.2) mm long, with bracts on lower third and often grading into 2–5 shorter leaves, recurved in bud and in fruit; *buds* narrowly ovoid; *bracts* linear-triangular, 1.2–1.5 × c. 0.25 mm, acute, with central vein scarcely visible, glabrescent. *Calyx* scarcely accrescent; *outer calyx lobes* narrowly elliptic-oblong, 4.2–4.4 × 1.4–1.6 mm, as long or scarcely shorter than inner ones, obtuse, without central ridge, pubescent or puberulous especially towards the apex, glabrescent; *inner calyx lobes* oblong-ovate, 4.8–5.0 × 1.8–2.3 mm, rounded or abruptly constricted into a short point, without ridge, glabrescent. *Petals* oblong-obovate to oblong-elliptic, 5.6–6.4 mm long, scarcely emarginate to lobed. *Stamens* 3–5 on one side of ovaries*; filaments* 1.2–1.3 mm long, 0.8–1.0 mm connate; *anthers* obloid, 1.5–1.7 mm long, abruptly constricted above and below. *Pistils* 2; *ovaries* obovoid but ± laterally compressed, with 4 ovules, glabrous, with styles attached to the lower half of the dorso-lateral surface and curved up on both sides of the stamen column to place the erect stigmas just above the apex of the anthers. *Fruit* glabrous. *Seeds* not seen. *Flowering:* September–November. **Fig. 1M, N.**

Distribution and ecology. Grows in open eucalypt woodland in central New South Wales (CWS, ST). Dry sclerophyll woodland of *Eucalyptus amplifolia, E. bosistoana* and *E. eugenoides* (*R.Miller 23-29*).

Conservation status. The species was only noted at two roadside locales and one other site in Bungonia State Conservation Area. *Hibbertia pilifera* is rare and possibly extremely vulnerable (R.T. Miller, pers. obs.; *R.Miller 23-29*). it could not be relocated at the type locality (Adams Lookout, vicinity Bungonia Gorge), but the species is cryptic, even when in flower.

Diagnostic features. Although superficially similar to *H. rufa* it is easily distinguished by its usually much branched habit above and below soil level, hairy branches and calyx lobes, cuneate bases of the leaf lamina, and 3–5 stamens. *Hibbertia pilifera* differs from *H. surcularis* by its hairy branches and calyx, calyx lobes without ridges towards the apex, 3–5 stamens and distinctly stalked flowers.

Variation. The appressed hairs on most parts of the plants will soon wear off, so that vestiture is best observed on distal parts of branches. It is particularly well developed below flowers where it is usually retained for a longer time. Some plants have hairs restricted to the region of several nodes below the flowers and only the occasional hair can be observed on the rest of the plant, but these hairs are usually well developed, i.e. they are not reduced hairs as sometimes found in *H. surcularis*.

The number of stamens varies from three to five but is usually specific to individual plants. Their filaments are usually almost completely connate into an erect column.

Etymology. In contrast to the very similar species, *H. rufa,* this species is on most parts of the plant 'hair-bearing', Latin, 'pili-fera' and hence the choice of epithet.

Specimen examined

New South Wales. **CWS:** *S.Bell 20, 21, 22*, Black Mountain, NE Scone, ix.2007 (AD, NSW). **CT:** *R.Miller 23-29*, Bungonia SCA, 15.x.2008 (AD).

Hibbertia pustulata Toelken, *sp. nov.*

A H. pilifera *et* H. surcularis *foliis costis centralibus tumescentibus, paginis abaxialibus pustulatibus disperses (tuberculi basales pilorum) filisque vix basale connatis differt.*

Typus: New South Wales, Mt Hay Road, N Leura, *C.P.Gibson 56*, 13.x.2006 (holo.: AD; iso.: K, MEL, NSW, NY).

Decumbent shrublets up to 0.15 m tall, sparsely branched; branches wiry, with long decurrent leaf bases, brown, glabrous. *Vestiture* not persistent, scattered short antrorse simple hairs on raised tooth-like tubercles which remain after the hairs have worn off, mainly restricted to abaxial surface and especially towards the margins and apex of leaves. *Leaves* without tufts of hairs in the leaf axils; *petiole* 0.2–0.6 mm long, dorsiventrally compressed; *lamina* linear, linear-elliptic to linear-lanceolate, (4.3–) 6.0–7.5 (–8.6) × (0.6–) 0.7–0.8 (–1.0) mm, acute with short tuft of simple hairs, with paler tubercle usually retained, with cuneate base, above flat and glabrous, below with central vein bulging over revolute margins and no tubercles visible between them, puberulous when young and soon wearing off, but retaining scattered paler hair tubercles mainly along the margins and towards the apex. *Flowers* single, terminal, sessile on all branches; *flower stalk* absent; *buds* narrowly ellipsoidal or rarely ovoid; *bract* triangular, 0.7–1.1 × 0.6–0.75 mm, acute to pointed, scale-like, without central ridge, glabrous or often with more or less dense, very short cilia; often subtended by 2 additional bracts or grading into reduced leaves, fleshy and narrowly oblong. *Calyx* scarcely accrescent; *outer calyx lobes* narrowly elliptic-lanceolate, (5.5–) 5.9–6.3 × 2.5–2.6 mm, acute to pointed, with scarcely raised central ridge distally, glabrous; *inner calyx lobes* lanceolate, rarely ovate, (5.6–) 6.0–6.5 × 3.2–3.4 mm, subequally as long as outer ones, without central ridge, glabrous. *Petals* obovate-spathulate, 7.6–9.3 mm long, distinctly emarginate. *Stamens* 4; *filaments* 1.0–1.2 mm long, free, basally connate; *anthers* narrowly obloid, 2.3–2.5 mm long, abruptly constricted above and below. *Pistils* 2; *ovaries* broadly obovoid but distinctly laterally compressed, with 4–6 ovules, glabrous, with styles attached to lower dorso-lateral surface and curved up on both sides of the anthers to place the erect stigmas above the apex of the anthers. *Fruit* glabrous. *Seeds* not seen. *Flowering*: August–October. **Fig. 1I–L.**

Distribution and ecology. 'Swamp in creekline' in central New South Wales (CT).

Conservation status. The species is recorded and conserved in the Blue Mountains and Wollemi National Parks, but further assessment is needed.

Diagnostic feature. *Hibbertia pustulata* is a little known species and differs from other species in the *H. rufa* group by the staminal filaments being scarcely connate basally, and by the scattered raised tubercles or bases of the short hairs on the abaxial surface of leaves. The species is also characterized by an unusually bulging central vein on the abaxial surface, by a cuneate leaf base, and by sessile flowers on all branches. As with other species in the *H. rufa* group, *H. pustulata* has usually four stamens.

Variation. One flower on an axillary short shoot was observed on a single specimen (*S.Bell 216*), whereas usually flowers are borne terminally on leafy long shoots.

Etymology. Since the pale persistent basal tubercles of the hairs are visible with the naked eye on the margins of the leaves, the epithet 'pustulata', Latin, 'pustulate' was chosen for this species.

Specimens examined

New South Wales. **CT:** *S.Bell 216*, SE Wollemi National Park, c. 300 m W Mt Tootie Road, 15.viii.2007 (AD, NSW); *C.P.Gibson 034*, Lacy Tableland, 2.x.1990 (AD); *C.P.Gibson s.n.*, Wentworth Falls, 25.iii.2006 (AD, NSW).

Hibbertia rufa N.A.Wakef.

Victorian Naturalist 72: 119 (1955); J.H.Willis, Handb. Pl. Victoria 2: 388 (1973); G.J.Harden & J.Everett, Fl. New South Wales 1: 301 (1990); Toelken in N.G.Walsh & T.Enwisle, Fl. Victoria 2: 307 (1996); A.M.Gray (2009) 92 Dilleniaceae version 2009.2. in M.F.Duretto (Ed.) Fl. Tasmania Online; A.Fairley & P.Moore, Native Pl. Sydney Region 78 (2010). — **Type**: Victoria, Reedy Creek, 3 miles E Cann River, *J.H.Willis & N.A.Wakefield* s.n. (holo.: MEL 35552; iso.: MEL 658094; NSW 86703).

Hibbertia stricta var. *pedunculata* Maiden & E.Betche, Proc. Linn. Soc. New South Wales 24: 640 (1900).

Shrublets rarely up to 0.3 m tall, trailing to scrambling, rarely erect-spreading, with rhizome or branches rooting and/or often suckering; branches wiry and up to 0.5 m long, with leaf bases ± flanged, glabrous rarely puberulous, usually reddish-brown. *Vestiture* scattered

fine short simple hairs occasionally on the branches, on leaves in particular on flanks and terminal, soon wearing off or usually absent except for intrapetiolar tufts of simple hair in distal leaf axils. *Leaves* with short axillary tufts up to 0.2 mm long, *petiole* 0.2–1.3 mm long, dorsiventrally compressed; *lamina* linear-lanceolate to linear-triangular, (1.8–) 4–9 (–10.6) × (0.8–) 1–2 (–2.5) mm, acute to pointed, with one to usually few terminal hairs wearing off soon, with truncate to cordate base, above flat to slightly convex and sometimes ± grooved along the central vein, glabrous or sometimes with few antrorse hairs along the upper flanks but wearing off soon, below with narrow but strongly revolute margins (glabrescent) and more than twice broader central vein (glabrous), but with no undersurface visible except for a row of papillae often along the slit. *Flowers* terminal on short shoots, usually in successive distal leaf axils and forming a terminal thyrse (rarely a thyrsoid) on major branches; *flower stalk* filiform, (0.3–) 5–15 (–24.4) mm long (excluding short shoot = pedicel), with bracts at the base, curved downwards in bud and fruit; *buds* narrowly ovoid; *bracts* (primary) linear-lanceolate to elliptic-triangular, 0.5–1.4 × 0.2–0.4 mm, acute, rarely obtuse, glabrous except for often with terminal tuft wearing off soon, scale-like with central vein scarcely visible, subtended by (2) 3 or 4 similar additional bracts (bract-like leaves of short shoot), which are sometimes smaller (less than 0.3 mm) than the primary bract. *Calyx* scarcely accrescent; *outer calyx lobes* narrowly lanceolate-oblong to elliptic-oblong, (2.2–) 3–4.5 (–5.3) × 1.8–2.4 mm, longer to shorter than inner ones, acute, obtuse becoming rounded, without central ridge, glabrous; *inner calyx lobes* broadly elliptic to oblong-obovate, (2.3–) 3.2–5 (–5.6) × (2.0–) 2.2–3.6 mm, rounded or cuspidate, without ridge, glabrous. *Petals* obovate, (3.5–) 5.5–7 (–8.2) × 2.4–) 2.8–4 mm, ± deeply emarginate. *Stamens* (3) 4, on one side of ovary; *filaments* 0.9–1.3 mm long and 0.9–1.1 mm connate; *anthers* obloid, 1.4–1.6 mm long, abruptly constricted above and below. *Pistils* 2; *ovaries* broadly obovoid and laterally compressed, with (2) 4 ovules, glabrous, with styles attached to the lower half of the dorso-lateral surface and curved up on both sides of the stamen column to place the erect stigmas just above the apex of the anthers. *Fruit* glabrous. *Seeds* not seen. *Flowering:* September–November. *Common name:* Brown Guinea-flower (Gray 2009). **Fig. 1O, P.**

Distribution and ecology. Locally common in moist heath-like vegetation or along streams rarely overtopped by eucalypts in southern New South Wales (CT, SC), eastern Victoria (EG) and rare in Tasmania (TSE).

Conservation status. Widespread and present in several conservation areas in southern New South Wales and Victoria, but known only from one locality in north-western Tasmania.

Diagnostic features. Prior to its segregation by Wakefield (1955), *H. rufa* was included in the *H. acicularis* complex. *Hibbertia rufa* is, however, easily distinguished from other species in the *H. acicularis* group by the absence of the typical terminal awn on the leaves, and differs from species in the *H. rufa* group by the following combination of characters (cf. also Table 1): leaf lamina with cordate base, filaments connate and stalked flowers borne on axillary short shoots at successive nodes. Occasionally the thyrse thus formed has only a single flower, or rarely, a flower in terminal position (thyrsoid) is also found. The length of the short shoots and the peduncles varies and might in rare cases be almost absent as in, for instance, *J.Crawford & L.Williams CBG 43386* (from New South Wales), *A.C.Beauglehole 34440* (from Victoria) and *W.Fitzgerald MEL 35557* (from Tasmania), but the basal scales at successive nodes are obvious. Wakefield (1955) commented on such depauperate specimens, which are diminutive in every respect. The leaves are, for instance, only (1.5–) 3.0–3.8 (–5.5) mm long.

Variation. This is an extremely variable species. Not only is there variation in the sizes of different organs, but the habit varies from suberect tufted plants to plants with long trailing branches up to 50 cm long. The leaf lamina is triangular in some populations, whereas it is almost linear in others; the flower stalk, usually a pedicel, is almost absent in depauperate plants but more commonly 5–15 (–24.4) mm long with subequal to smaller lower bracts. The size of the flower clearly reflects the conditions under which the plants were growing.

While plants from the Central Tableland of New South Wales are usually very vigorous, a specimen from Boyd River near Jenolan Caves (*J.Crawford & L.Williams CBG 43386*) is very small in all respects and grades into the generally smaller plants from Tasmania (Wakefield 1955). Additional specimens completed the range and a recent collection from Tasmania indicated that plants there are generally smaller (Gray 2009).

Typification. The holotype sheet (MEL 35552, det. N.A. Wakefield) contains four pieces, each with typical flowers and leaves of the species and is expressly described as "pieces all from a single plant". The isotype (MEL 658094, also det. N.A. Wakefield) "was recovered from the Victorian Reference Collection". A note on the holotype by J.H.Willis: "part of the material donated to Sydney Herbarium, 1961" accounts for the isotype NSW 86703 (without det. N.A.Wakefield).

Selection of specimens examined (39 seen)

New South Wales. **CT:** *L.G.Adams 1478*, 5 miles E Nerriga, 27.x.1965 (CANB; B, E, K, L, MEL, NSW, US – *n.v.*); *J.D.Briggs 692*, Paddys River Bridge, 2.3 km NW Penrose, 20.x.1980 (NSW; CANB – *n.v.*); *J.Crawford & L.Williams CBG 43386*, near Boyd River, between Jenolan & Kanangra (CANB); *R.Pullen & J.Story 4983*, c. 2 km W Mt Corang, 26.ix.1973 (NSW).

Victoria. **EG:** *A.C.Beauglehole 34440*, W Genoa River, 7.xi.1973 (MEL); *R.D.Hoogland 11917*, c. 2 mls W Genoa, 27.xi.1970 (MEL; CANB – n.v.); *J.H.Willis MEL 35553*, Genoa Creek, 31.x.1969 (MEL).

Tasmania. **TSE:** *L.Rodway s.n. (sub W. Fitzgerald)*, Georges Bay, x.1892 (HO 3043, MEL 35557).

Hibbertia surcularis* Toelken, *sp. nov.

Hibbertiae rufae *similis sed habitu surrecto ramoso caudice surculare, basibus cuneatis laminarum, lobis calicis sine costis ad apices, foliorum floribusque terminalibus sessilibus; a* H. pilifera *ramis et calicibus glabris, lobis calicis sine costis ad apices, floribus sessilibus terminalibus et plerumque 4 staminibus differt.*

Typus: New South Wales, Bark Hut Swamp in Boonoo Boonoo Forest Reserve, *H.R. Toelken 7979,* 20.x.1989 (holo.: AD; iso.: BRI, CANB, K, B, MO, NSW, PERTH).

Hibbertia rufa auctt. non N.A.Wakef.: N.C.W.Beadle, Stud. Fl. N.E. New South Wales 3: 255 (1976), p.p.; G.J.Harden & J. Everett, Fl. New South Wales 1: 301 (1990), p.p..

Shrublet rarely up to 0.3 m tall, erect-spreading, branching (suckering) mainly from underground rhizome; branches filiform to thin-wiry, with distinct decurrent leaf bases, reddish-brown, glabrous. *Vestiture* absent except for one or two short terminal hairs on the acute apex of leaves and calyx lobes. *Leaves* without axillary leaf tufts; *petiole* 2–3.5 (–4.5) mm long, dorsiventrally compressed; *lamina* linear to linear-elliptic, (3.9–) 5.0–8.0 (–10.2) × (0.5–) 0.6–0.8 mm, acute to pointed with 1 or 2 terminal hairs, wearing off soon, gradually tapering into petiole, above ± flat and glabrous, below with strongly revolute margins and much broader central vein ± flush, with undersurface nor teeth visible between the two, glabrous. *Flowers* sessile, terminal, axillary towards the end of main branches, subtended by a ring of 3, 4 bracts; *peduncle* absent; *buds* narrowly ovoid; *bracts* linear-triangular to subulate, 0.9–1.2 x 0.2–0.3 mm, acute, with central vein scarcely visible, glabrous. *Calyx* not accrescent; *outer calyx lobes* elliptic-oblong, (3.6–) 3.8–4.5 (–4.8) × (1.6–) 1.8–2.1 mm, slightly shorter than inner ones, pointed to acute, ridged on upper third, glabrous; *inner calyx lobes* oblong-ovate, (3.7–) 4.0–4.7 (–5.0) × (2.4–) 2.6–3.0 mm, abruptly constricted into a short point, slightly ridged towards the apex, glabrous. *Petals* obovate, 5.6–7.7 mm long, emarginate to slightly lobed. *Stamens* 4*; filaments* 1.0–1.2 mm long, 0.8–1.0 mm connate; *anthers* obloid, 1.6—1.8 mm long, abruptly constricted above and below. *Pistils* 2; *ovaries* obovoid but laterally compressed, with (3–) 4 (–5) ovules, glabrous, with style base attached to the lower dorso-lateral ridge and then curved up on either side of the stamen column to place the erect stigmas just above the apex of the anthers. *Fruit* not seen. *Flowering:* October, November. **Fig. 1Q, R.**

Distribution and ecology. Grows in damp or swampy areas in sedge- or heathland, in or surrounded by, eucalypt forests or woodland, often along creeks, in New South Wales (NT).

Conservation status. Locally common in conserved areas (*J.R.Hosking NSW 224543*, *Toelken 7979*).

Diagnostic features. *Hibbertia surcularis* has very similar flowers with connate filaments to *H. rufa*, but is distinguished (cf. Table 1) by its habit of erect branched shrublets interconnected by a suckering subterranean rhizome, by cuneate leaf bases, and terminal sessile flowers. It has a more shrubby habit than the similar *H. pilifera* but differs by its glabrous branches and calyx lobes, usually four stamens and terminal sessile flowers. *Hibbertia pustulata* superficially resembles *H. surcularis*, which differs by its connate filaments and smooth leaves.

Variation. The central vein is broad and usually flush with, or rarely slightly recessed to the revolute margins on either side of it. It was never found to bulge or protrude above the margins, as is commonly observed in *H. pustulata*.

Notes. The existence of this species with sessile flowers was mentioned in several previous floras (e.g. Harden & Everett 1990), but has never been followed up with the detailed research needed, probably because of a lack of specimens.

Etymology. A plant of this species consists of a great number of erect aerial tufts of an ever increasing area as the underground rhizome 'suckered', Latin, 'surcularis'.

Specimens examined

New South Wales. **NT:** *P.G.Kodela 201, P.D.Hind & T.A.James*, Grass Tree Swamp, near junction of Racecourse Trail and Spokes Trail, Werrikimbe National Park, 8.xi.1992 (AD, CANB, NSW, UNSW- n.v.); *R.G.Coveny 16577 & A.J.Whalen*, Basket Swamp picnic area. 9 km from Mount Lindesay Highway, 14.x.1993 (AD; BRI, CANB, MEL, NSW- n.v.); *R.D.Hoogland 11824*, near Mulligans Hut, Gibraltar Range National Park, 22.xi.1970 (CANB, K; L, NSW – *n.v.*); *J.R.Hosking NSW224543,* Werrikimbe National Park, l0.x. 1987 (NSW; NE – *n.v.*); *C.Stuart 267,* Sandy Creek, Nov. (MEL 1003812/3/5).

5. *H. sericea* (R.Br. ex DC.) Benth. group

When *H. puberula* Toelken was described in a taxonomic revision of the *H. sericea* species-group (Toelken 2000) the research was based on a few specimens collected before 1954, which provided the impression of a very rare and endangered, or possibly extinct, species. In the meantime many additional collections have demonstrated that plants of this species complex are never common, but have a much wider range than was originally known. They are no longer recorded only from populations along the Central Coast of New South Wales, but recent accessions extend their distribution inland north of Sydney as far as Wollemi National Park and south to Morton National Park. Collections of material from many plants from a few bigger populations provide a much needed wider insight into the variation of the species. Thus, the unusual form recorded from Bankstown Airport could now be assessed in a broader morphological context. All specimens examined are cited here, not only to show on what large foundation the following taxonomic changes are based, but also to publish these records to demonstrate the

conservation value of natural vegetation in small local parks and reserves, where these not-previously recorded plants were found. These are last vestiges from the rapidly expanding urban development.

Hibbertia puberula is placed in the *H. sericea* group as it shares with those species the slightly recurved distal margins of the outer calyx. The distinctive feature of the *H. puberula* complex is the erect obloid ovary with an almost horizontal upper surface on the side of which the style is attached, usually at the apex, but in most of the specimens from Morton National Park it is more or less lateral. The ovary is covered with normally few, very short, simple hairs. At times these hairs are also mainly restricted to areas along the margins of the ovaries (Toelken 2000, fig. 7G), but they are rarely quite glabrous. *Hibbertia puberula* is unusual in the *H. sericea* group, because of the larger number of normally subequal stamens. Usually more than ten stamens (except in subsp. *extensa*) occur in a dense cluster, with the base of the filaments distinctly connate to one side of the ovaries. These, and the frequently long simple hairs (strigose to hirsute) on the calyx it shares with, and gives *H. puberula* superficial similarity to a group of species, which Bentham (1863) included in *H. stricta* var. *hirtiflora* Benth., but is here placed into the *H. strigosa* group (cf. below). *Hibbertia puberula* is, however, distinguished by recurved distal margins of the outer calyx and obloid ovaries (obovoid in the *H. strigosa* group), which are usually puberulous with scattered short simple hairs (usually hirsute and densely covered with fascicled hairs in the *H. strigosa* group). The following re-assessment and enlarged description of *H. puberula* with the aid of many more specimens reveals a very variable species complex with a number of local forms.

***Hibbertia puberula* Toelken**

J. Adelaide Bot. Gard. 19: 27 (2000). — **Typus**: New South Wales, Yowie Bay, *A.A.Hamilton s.n.*, 14.xi.1908 (holo.: NSW 101955 (sheet two); iso.: NSW 101955 (sheet one), CANB).

Shrublets up to 0.25 m tall, decumbent or rarely suberect, much to sparsely branched or spreading; branches wiry to stiff from a woody stem or base, with decurrent leaf bases more or less flanged, pubescent to hirsute mainly between flanges, rarely glabrescent or glabrous. *Vestiture* often not persistent, with spreading longer over shorter simple hairs on all parts of the plant; *on branches* with few to many (rarely glabrous) mainly longer hairs (but varying very much in actual length) over much shorter ones, often predominantly in the grooves between flanges of the leaf bases, becoming appressed and wearing off soon; *on leaves above* with scattered spreading antrorse simple hairs becoming longer towards the margins, often wearing off; *on leaves below* with few scattered hairs as above on the revolute margins but not on the central vein, wearing off; *on bracts* with finer but similar hairs to leaves; *on outer calyx lobes* outside moderate to dense, with erect short hooked hairs overtopped by longer tubercled straight hairs up to 1.3 mm long, often becoming bristle-like particularly on the margins and the base and receptacle, persisting, inside dense, with fine, often silky appressed antrorse hairs; *on inner calyx lobes* outside and inside usually similar to the outer lobes, but hairs finer and decreasing in number and size towards the glabrous, membranous margins. *Leaves* usually with dense intrapetiolar tuft spilling over into grooves between flanges; *petiole* 0–0.6 mm long, ± flattened; *lamina* linear-lanceolate to oblong-lanceolate or oblong-elliptic, (1.2–) 2.8–5 (–7.6) × (0.5–) 0.7–1 (–1.2) mm, ± abruptly constricted into petiole, acute and usually with a terminal tuft of hairs wearing off soon, often becoming obtuse, above ± flat and sparsely pilose to glabrescent, below revolute margins and recessed to bulging broader central vein obscuring the undersurface, sparsely pilose to glabrous on the margins. *Flowers* single and terminal, rarely in clusters of up to three from subtending axils; *pedicel* 0–3 mm long; *bracts* linear-elliptic to elliptic-lanceolate, (2.9–) 3.2–3.8 (–4.2) × (0.4–) 0.6–0.8 (–0.9) mm, leaf-like but flatted with central vein ± visible, short pilose, rarely glabrous. *Calyx* distinctly accrescent; *outer calyx lobes* lanceolate to ovate, (5.3–) 6–8 (–11.7) × (1.6–) 2–3 (–4.2) mm, frequently longer than inner lobes, acute to beaked, usually with raised ridge and recurved distal margins, hirsute, strigose, rarely pubescent to glabrescent; *inner calyx lobes* oblong-ovate to oblong-elliptic, (4.6–) 5–8 (–11.6) × (2.1–) 2.5–3.5 (–3.7) mm, acute to cuspidate and with lateral membranous margins rarely up to the apex when obtuse and mucronate, hirsute to finely pilose, decreasing towards the margins. *Petals* broadly obovate to oblanceolate, or rarely oblong-oblanceolate, 5.5–10.6 mm long, ± bilobed. *Stamens* (4–) 10–14 (–18); *filaments* (0.6–) 1.4–1.7 (–1.9) mm long, up to one-third connate basally; *anthers* obloid, (0.8–) 1.4–1.8 (–2.1) mm long, subequal, rarely unequal, abruptly constricted above and below. *Pistils* 2; ovaries erect-obloid and usually horizontally truncate, (4–) 6 (–8) ovules, puberulous, rarely shortly pubescent, with style attached apically, rarely laterally, then curved back- and upwards on either side of the anthers with style well above or rarely at the apex of anthers. *Fruit* puberulous to glabrescent with simple hairs. *Seeds* oblong-obovoid to almost obloid, 1.6–1.8 × (1.2–) 1.3–1.4 mm, brown; *aril* with fleshy base surmounted by one-sided membranous cup covering one-third to half of seed.

Notes. The extra specimens now available introduced a much wider range of variation in the *H. puberula* complex. Specimens from the Central Coast can frequently be recognized by almost sessile leaves, broadly ovoid to ellipsoidal buds with apices of the calyx erect to incurved, and often more than one flower is born terminally on branches, while plants from more inland localities have usually petiolate leaves, slender ovoid to ellipsoidal buds with more or less recurved apices of the calyx and a single terminal flower on branches. None

of these characters can be decisively used to distinguish these forms.

The terminal flower clusters are formed by axillary growth from one or two leaves below the bract of the terminal flower and, in keeping with other species of the *H. sericea* group with fascicled hairs (Toelken 2000, fig. 1), immediately develop a terminal flower after usually two nodes with distinct internodes between, so that it becomes a more or less corymbiform cluster. (This is also a distinction from *H. stricta* s.l., which has usually spikiform (pyramidal) terminal clusters). Similar, but loosely branched cymbiform terminal inflorescences have been observed on only one collection (Turpentine Road, Flat Rock Creek, *R.T. & J.Miller 22/30.x.2010*).

The most southern population of *H. puberula*, as represented by this and other mass collections, as well as *R.D.Hoogland 11702* and *E.Gauba NBG4784*, is a particularly interesting extension of the species, as most of the flowers, though large, show a distinct reduction of hairs on the calyx and, more significantly, the styles tend to be laterally attached to the ovaries, similar to those of *H. cistiflora* in the *H. stricta* group. However, this phenomenon, indicative of a convergent development, can be observed in different stages on different plants, varying from an apically attached style curving down- and backwards to being attached laterally.

The calyx lobes of most of the specimens identified as belonging to the *H. puberula* complex are hirsute to strigose (cf. Toelken 2000, fig.7E, F) on the outer surface, but in a few specimens both the shorter hooked hairs as well as the straight overtopping longer ones are very short or absent on plants from a few different localities (cf. variation under subsp. *glabrescens*). Among these, the plants from Bankstown Airport are smaller with thread-like branches and have consistently smaller calyx lobes, which are up to 2.7 mm broad, so that they are here described as subsp. *glabrescens*. The calyx of some flowers of subsp. *puberula* from Voyager Point (*R.T.Miller & C.P.Gibson 52/20.x.2006*) are of similar size, but hirsute and with a distinct terminal ridge on the outer calyx lobes. Furthermore, the flowering calyx of one plant must always be compared with other specimens at a similar stage, as the calyx (accrescent) elongates after flowering. Specimens from Lucas Heights are an extreme example, as the outer calyx lobes of a flower are 7.2 mm long and those of a fruit on the same specimen (*R.T.Miller 3/16.x.2007*) are 11.6 mm long.

Of all the variation observed, *H. puberula* subsp. *extensa* is very unusual, as its androecium of commonly six stamens was previously unknown in *H. puberula*, which has ten or more stamens. There is a distinct gap between the two types of stamen numbers, as, unlike specimens of the typical subspecies from Simmos Beach Recreation Reserve (*R.T.Miller 24–32/2.xi.2007*), which has a range of stamens from 15–18, no specimen has as yet been recorded to complete the range from (4–) 6 or 7 stamens of the subsp. *extensa*. However, the wide variation recorded for the typical subspecies suggests this new form should be recognized at subspecific level. The anthers of subsp. *extensa* also tend to be smaller like those of the subsp. *glabrescens*, and their cuneate base into the filaments is rarely observed in the other subspecies.

Key to subspecies of the *H. puberula* complex

1. Stamens (4–) 6 or 7; lateral branches usually spreading up to about right angles to the main axis . . . . . ***H. puberula* subsp. *extensa***

1: Stamens (9) 10–14 (–18); irregularly and commonly untidily branched

2. Anthers (1.3–) 1.4–2.1 mm long; outer calyx lobes distinctly ridged toward the apex, strigose to hirsute or if pubescent to glabrescent then (2.5–) 2.6–3.0 (–3.8) mm broad when flowering . . . . . ***H. puberula* subsp. *puberula***

2: Anthers 0.9–1.3 mm long; outer calyx lobes 1.6–2.1 mm broad when flowering, scarcely ridged towards the apex, puberulous to glabrescent . . . . . ***H. puberula* subsp. *glabrescens***

Hibbertia puberula* subsp. *puberula

Branches wiry to stiff-woody from woody stems. *Leaf lamina* mainly lanceolate. *Outer calyx lobes* lanceolate to ovate, (7.3–) 7.8–9.3 (–11.6) × (2.5–) 2.6–3.0 (–3.8) mm, acute to beaked with strongly recurved margins and distinctly raised central ridge towards the apex, strigose or hirsute to rarely puberulous; *inner calyx lobes* broadly elliptic to oblong-ovate, (6.9–) 7.3–7.8 (–10.1) × (2.8–) 3.15–3.3 (–3.7) mm, with innermost two acute to ± cuspidate above broad membranous margins, hirsute to strigose, rarely pubescent along the central ridge becoming smaller to glabrous towards the margins. *Stamens* (9–) 10–14 (–18); *anthers* (1.3–) 1.4–2.1 mm long. *Flowering*: October–December (January).

Distribution and ecology. Occurs in a wide range of habitats, but usually low heath, on sandy soil or rarely in clay, with or without rocks underneath; known in New South Wales mainly from near Sydney (CC), but also from and near Morton National Park (SC, ST).

Conservation status. This subspecies occurs locally occasional to frequent and is conserved in a number of parks (cf. Specimens examined), i.e. it seems to be adequately conserved.

Variation. The few previous collections available have been disconcertingly variable, but mass collections from a few localities revealed that individual populations are often very variable in the size and number of hairs on various organs. Buds vary from almost spherical to narrow-ellipsoidal to -ovoid with lanceolate to ovate outer calyx lobes, each with an incurved, erect or recurved apex and more or less densely covered with spreading, straight and smaller hooked hairs of varying length.

Flowers have usually 12–14 stamens in this subspecies, but the number varies locally from 9 or 10 at Wollemi National Park to 18 in one specimen

from Yeramba Lagoon (*C.P.Gibson & R.T.Miller 50/14.x.1993*). Specimens from Simmos Beach Recreation Reserve show a few flowers with 15 to 17 stamens, while other flowers of similar plants of the same population have 12 to 14 (*R.T.Miller 24–32/2.xi.2007*). The filaments are up to one-third basally connate. Usually the anthers are described as subequal and forming a range from the slightly smaller to larger ones, but occasionally one or two distinctly larger ones were observed.

The typical obloid ovaries are surmounted by a horizontal style base and, while the style is usually attached at the apex, it is sometimes more or less dipping to a lateral position in a number of populations, mainly from Morton National Park. This must not be confused with fruiting specimens, where the bulging developing seeds often displace the position of the style attachment. While the ovaries are usually puberulous, they may vary from pubescent (*R.T.Miller 111–113/20.xi.2007*) to almost glabrous (*R.T.Miller 33–43/12.x.2007*).

Additional specimens examined

New South Wales. **CC:** *C.P.Gibson 28/11.x.1990,* Picnic Point at Blackwall (AD, NSW); *C.P.Gibson 51/1.x.2006*, eastern side of Yeramba Lagoon (AD, NSW); *C.P. & H.K.J.Gibson 95*, Stony Waterhole, Wollemi National Park, 23.xi.2009, (AD, NSW); *C.P. & H.K.J.Gibson 96*, downstream from Stony Waterhole, Wollemi National Park, 23.xi.2009, (AD, NSW); *C.P.Gibson & R.T.Miller 27/23.x.1990,* Mickeys Point (AD, NSW); *C.P.Gibson & R.T.Miller 31/29.x.2005,* near Kings Waterhole, Mellon Creek (AD, NSW); *C.P.Gibson & R.T.Miller 44/ 25.xi.1988,* Voyager Point (AD); Picnic Point, western side of Yeramba Lagoon (AD, NSW); *C.P.Gibson & R.T.Miller 52/20.x.2006*, Voyager Point (AD, NSW); *R.Johnstone 2689 & A.E.Orme*, Warrimoo, 1.2 km along bush track from (locked) gate at the end of Greens Road, 6.xii.2009 (AD, NSW); *R.T.Miller s.n.*, Blackwall, Georges River, plateau top adjacent to Henry Lawson Drive, 1.xi.2006 (AD, NSW); *R.T.Miller 1–5/12.x.2007*, Simmos Beach Recreation Reserve (AD, NSW); *R.T.Miller 1–3/16.x.2007*, Lucas Heights (AD, NSW); *R.T.Miller 4–12/12.x.2007,* Peter Meadows Reserve (AD, NSW); *R.T.Miller 12/12.x.2010*, 72.7 km S of Picton Road, E side of Hume Hwy, along Optic Fibre cable track (AD); *R.T.Miller 24–32/2.xi.2007*, Simmos Beach Recreation Reserve (AD, NSW); *R.T.Miller 33–43/12.x.2007*, The Basin Reserve, Kentlyn (AD, NSW); *R.T.Miller 46–58/2.xi.2007*, The Basin Reserve, Kentlyn (AD, NSW); *R.T.Miller 59–64/2.xi.2007*, Freres Crossing Reserve, Kentlyn (AD, NSW); *R.T.Miller 76/9.i.2007*, Heathcote Road (AD); *R.T.Miller 80, 82, 83/23.x.2008*, Crownland off Sackville Road (AD); *R.T.Miller 88*, Marley Head, Royal National Park, 14.x.2007 (AD); *R.T.Miller 111–113/20.xi.2007*, Little Forest, Lucas Heights (AD, NSW) *R.T.Miller & C.P.Gibson s.n.*, Picnic Point, Yeramba Lagoon. 12.x.2006 (AD, NSW); *R.T. & J.Miller 19a, b/9.xi.2010*, near Lucas Heights, near walk marker 7 (AD, NSW); *R.T. & J.Miller 50A–T/8.xii.2010*, The Basin Reserve, Kentlyn (AD); *R.T.& J.Miller 51A–N/8.xii.2010,* Old Kent Road, Kentlyn (AD); *R.T.Miller & J.Peters s.n.*, Voyager Point, 1.x.1996 (AD, NSW); *A.E.Orme 732 & 733*, Warrimoo, 250 m along SE fork of Greens Road firetrail. The fork is 1.5 km from the beginning of Greens Road and Waratah Road, 7.xi.2009, (AD, NSW). **SC:** *R.T. & J.Miller 13A–D/30.x.2010*, Turpentine Road, near Flat Rock Creek, 30.x.2010 (AD, NSW); *R.T. & J.Miller 16–22/30.x.2010*, Turpentine Road, Flat Rock Creek, (AD, NSW); *R.T. & J.Miller 21A, B/30.x.2010*, Turpentine Road, c. 100 m E Flat Rock Creek (AD, NSW); *R.T. & J.Miller 23, 24/30.x.2010*, near Wandean Road, power-line easement, (AD, NSW) *R.T. & J.Miller 29A–E/7.xi.2010*, eastern side of Flat Rock Creek Dam, Mundamia (AD); *R.T. & J.Miller 28A–C/7.xi.2010*, Triplarina, S Mundamia Road, (AD, NSW); *R.T. & J.Miller 70/10.x.2010*, Wandean Road, powerline easement (AD); *R.T. & J.Miller 72/10.x.2010*, Wandean Road (AD). **CT:** *E.Gauba NBG4784*, Marulan to Berrima, 1.xii.1950 (CANB). **ST:** *R.D.Hoogland 11702*, between Sassafras and Tianjara Falls, 26.xi.1969 (NSW; CANB, n.v.); *R.T. & J.Miller 15A–M/30.x.2010*, Tianjara Falls car park (AD, NSW).

Hibbertia puberula* subsp. *extensa* R.T.Mill., *subsp. nov.

A subspeciebus aliis staminibus (4–) 6, 7 et antheris 0.8–1.2 mm longis ramisque lateralibus circiter orthogoniis expansis differt.

Typus: New South Wales, south of Appin Road, upper George River catchment, *R.T.Miller 102 & A.Henderson*, 8.x.2007 (holo.: AD; iso.: NSW).

Branches stiff-woody and lateral ones spreading up to about right angles. *Leaf lamina* mainly lanceolate. *Outer calyx lobes* ovate, (6.1–) 66–72 (–7.9) × 3.1–3.5 (–3.8) mm, acute to beaked with ± strongly recurved margins and distinctly raised ridge towards the apex, strigose to hirsute; *inner calyx lobes* elliptic rarely oblong-ovate, (4.2–) 4.5–4.8 (–5) × 2.9–3.2 (–3.4) mm, with innermost two abruptly constricted into minute terminal point continuous with broad membranous margins, hirsute to strigose with hairs becoming smaller towards the margins. *Stamens* (4–) 6 (7); *anthers* 0.8–1.2 mm long. *Flowering*: October, November (March, April). **Fig. 2Y–BB.**

Distribution and ecology. Grows often in shallow soil on rock shelves or localized in upland swamps with heath on upper headwaters of the Georges River and in rock-plate heath on the Wangandery Tableland, New South Wales (CC).

Conservation status. Apparently rare and localized (*R.T. & J.Miller 109/12.x.2007*).

Variation. In spite of their often isolated occurrence very little variation was observed in the material examined. The specimens from south of Appin had usually 6 stamens, whereas several flowers from the Wangandery Tableland had 7. The subspecies has generally very long straight hairs on the calyx and some of them are up to 1.3 mm long. Not only are the stamens shorter in this subspecies, but also the styles are short and robust and often just reach the apex of the anthers. These robust specimens are easily distinguished from superficially very similar plants with spreading branches of the typical subspecies from Lucas Heights (*R.T.Miller 111–113/20.xi.2007*) by the number and size of the anthers. While most of the specimens of this subspecies occur in a restricted area from Appin to Wedderburn, a collection from Sackville Road (*R.T.Miller 81/23.x.2008*) seems to indicate that the taxon has a much wider geographic range. This preceding specimen exhibits in addition to

six stamens also the robust spreading branching of the plants from the southern localities in spite of records of more slender forms of the typical subspecies nearby.

Etymology. The epithet 'extensa', Latin, 'stretched out, extended' refers to the impression created by the lateral branches spreading at about right angles to the main branches.

Specimens examined

New South Wales. **CC:** *R.T.Miller s.n.*, c. 3.5–4 km SE Appin township (AD); *R.T.Miller 67/18.iii.2007*, near Sarahs Knob via Woronora Dam Road (AD, NSW); *R.T.Miller 68/21.iii.2007*, Appin Road (AD, NSW); *R.T.Miller 71/iv.2007,* near Sarahs Knob (AD, NSW); *R.T. Miller 81/23.x.2008*, Crownland off Sackville Road (AD, NSW); *R.T. & J.Miller 103–108/16.x.2007*, S Appin Road (AD, NSW); *R.T. & J.Miller 109/12.x.2007*, S Appin Road (AD, NSW); *R.T & J.Miller 44A–C/17.xi.2010*, S Appin Road (AD; *R.T. Miller, J.Miller* and M. Krough *52A–G/* 8.xii.2010, Wedderburn, NSW Sports & Aircraft Club, walking tracks (AD). **CT:** *R.T. & J.Miller 1/12.xi.2005*,Wanganderry Tableland (AD, NSW) .

Hibbertia puberula* subsp. *glabrescens* Toelken, *subsp. nov.

A subspecie typica ramis filiformibus floribusque constanter parvioribus calice plerumque glabrecenti et usque ad 2.7 mm lato differt.

Typus: New South Wales, Bankstown Airport, *G.M.Cunningham s.n.*, 13.xii.2006 (holo.: AD200524; iso.: CANB, K, MEL, NSW).

Hibbertia sp. Bankstown (R.T.Miller & C.P.Gibson s.n. 18.x.2006) N.S.W. Herbarium in Australian Plant Census database (2011). *Hibbertia sp. nov. (Bankstown Airport)* C.P.Gibson, Bushland Bulletin 59: 4, 6 (2009).

Branches thread-like wiry from short stiff-woody stems. *Leaf lamina* mainly elliptic-oblong. *Outer calyx lobes* linear-lanceolate, (5.3–) 5.5–6.1 (–6.3) × 1.6–2.1 mm, not beaked and with scarcely recurved margins and faint central ridge towards the apex, glabrescent or sparsely pubescent; *inner calyx lobes* narrowly oblong-ovate, (4.6–) 4.8–5.2 (–5.6) × 2.1–2.3 (–2.7) mm, innermost two abruptly constricted into minute terminal mucro continuous with broad membranous margins, glabrous or glabrescent along central ridge. *Stamens* 12–14; *anthers* 0.9–1.3 mm long. *Flowering*: October, November (December). **Fig. 2CC–EE.**

Distribution and ecology. Subspecies *glabrescens* is known only from Tertiary alluvial soil along Airport Creek on Bankstown Airport and not from areas where subsequent fill has been deposited in between (Gibson 2007a, b). The plant assemblage is attributable to "Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion and is listed as an Endangered Ecological Community under the Threatened Species Conservation Act 1995" (NSW Scientific Committee 2010).

Conservation *status*. *Hibbertia puberula* subsp. *glabrescens* is endemic to New South Wales and is currently known to occur in only one population at Bankstown Airport in Sydney's southern suburbs. The population comprises fewer than 100 individuals (NSW Scientific Committee 2010) in an area of remnant vegetation periodically mown or slashed and is listed as 'Critically Endangered' under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and the N.S.W. *Threatened Species Conservation Act 1995* (TSSC 2009a, b).

Variation. The plants at Bankstown Airport are comparatively uniform, as one would expect for such a small and extremely localized population. However, the plants and especially also the calyx lobes are rarely entirely glabrous. Although specimens of some plants of the typical subspecies, especially from nearby Simmos Beach Reserve (*R.T.Miller 24–32/2.xi.2007*), as well as those from the much further south population along Turpentine Road near Sassafras (e.g. *R.T. & J.Miller AD15A–M*), show a variation from a hirsute or strigose through to glabrescent tomentum of the calyx lobes, they are always more robust plants and in particular, the calyx lobes are larger and especially broader. Some specimens of the mass collection *R.T.Miller 16-22/12.x.2007* are very similar to subsp. *glabrescens*, but can be distinguished by the shape of the calyx or by their strigose to hirsute calyx (*C.P.Gibson & R.T.Miller 27/23.x.1990*). Furthermore specimens from Bankstown Airport collected in subsequent years (since 2006) have not shown any significant change in morphology. Thus we must assume that a taxon has established itself here that is suited to the unusual ecological conditions artificially maintained by the Bankstown Airport management since about 1940.

Etymology. Since all organs of this subspecies have very few small and delicate hairs which usually wear off soon, the epithet 'glabrescens', Latin, 'glabrescent' seemed appropriate.

Specimens examined

New South Wales. **CC:** Bankstown Airport, *C.P.Gibson 49/6.x.2006* (AD); *R.Johnstone 2646 & G.Errington*, 6.xi.2009 (AD, K, NSW); *R.T.Miller & C.P.Gibson 1–4/18.x.2006* (AD).

6. *H. stricta* (R.Br. ex DC.) F.Muell. group

The *H. stricta* species-group (segregated from Bentham's *H. stricta* supercomplex: cf. Toelken 2010b) is represented here by four, often misinterpreted species. This group occurs mainly in New South Wales, Victoria and South Australia. Species are defined by the following combination of characters: very short or absent intrapetiolar tufts of hairs; usually strongly bulging central vein of leaves so that the undersurface is not visible; sessile flowers each subtended usually by one to several bracts; and usually less than 8 stamens, of which the central one/s are often distinctly longer. In contrast to the species of the *H. strigosa* species-group (cf. below) the hairs on the calyx are short and do not vary much in size.

The broad concepts of species adopted here are similar to the interpretation Wakefield (1955) presented,

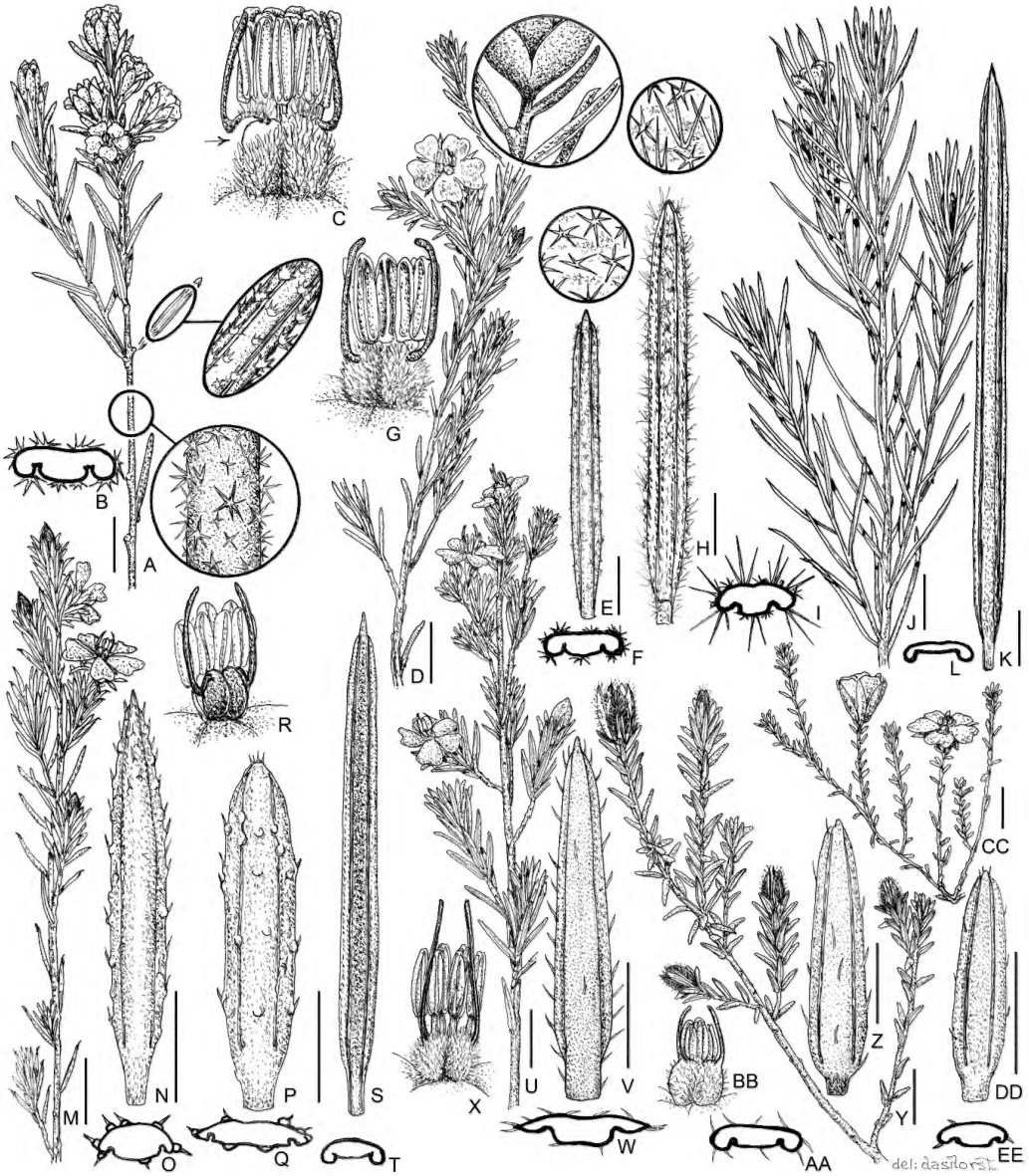

Fig. 2 A–**C** ***Hibbertia strigosa***: **A**, flowering branch; **B**, transverse section through mid-leaf; **C** flower with petals removed. **D**–**G** ***H. stricta*** **subsp. *stricta***: **D** flowering branch; **E** leaf from below; **F** transverse section through mid-leaf; **G** flower with petals removed. **H, I** ***H. stricta*** **subsp. *furcatula***: **H** leaf from below; **I** transverse section through mid-leaf. **J**–**L** ***H. sulcinervis***: **J** flowering branch; **K** leaf from below; **L** transverse section through mid-leaf. **M**–**O** ***H. cistiflora*** **subsp. *cistiflora***: **M** flowering branch; **N** leaf from below; **O** transverse section through mid-leaf. **P, Q** ***H. cistiflora*** **subsp. *quadristaminea***: **P** leaf from below; **Q** transverse section through mid-leaf. **S, T** ***H. cistiflora*** **subsp. *rostrata***: **S** leaf from below, **T** transverse section through mid-leaf. **U**–**X** ***H. oxycraspedota***: **U** flowering branch, **V** leaf from below; **W** transverse section through mid-leaf; **X** flower with petals removed. **Y**–**BB** ***H. puberula*** **subsp. *extensa***: **Y** flowering branch; **Z** leaf from below; **AA** transverse section through mid-leaf; **BB** flowers with petals and calyx removed. **CC**–**EE** ***H. puberula*** **subsp. *pubescens***: **CC** flowering branch; **DD** leaf from below; **EE** transverse section through mid-leaf. Scale bars: habits (**A**, **D**, **J**, **M**, **U**, **Y**, **CC**) 10 mm; leaves (**E**, **H**, **K**, **N**, **P**, **S**, **V**, **Z**, **DD**) 2 mm. — **A**–**C** *R.Bates 11140*; **D**–**G** *K.O'Ryan 50 & R.Windsor*; **H, I** *A.Fairley s.n.*; **J**–**L** *R.G.Coveny NSW102007*; **M**–**O** *R.D.Hoogland 12240*; **P**–**R** *H.R.Toelken 9522*; **S, T** *F.Robbins sub A.C.Beauglehole 3679*; **U**–**X** *R.T. & J.Miller 78/3.viii.2005*; **Y**–**BB** *R.T. & J.Miller 108/16.x.2007*; **CC**–**EE** *G.M.Cunningham AD200524.*

except that more taxa are included by Toelken (2010b) and in this paper. The combination of the individual characters in different species and their juxtaposition in Table 2 will hopefully provide a clearer image of the species concerned.

Wakefield (1955) also referred to the *H. calycina* complex (Toelken, in prep.), but this is not included as *H. calycina* is now considered to belong in the *H. strigosa* group, because it differs from the *H. stricta* group by the presence of long simple, or rarely forked hairs usually overtopping the short fascicled hairs on branches, leaves and particularly on the outer calyx lobes. It also has 8–12 usually subequal stamens and the ovaries are hirsute (cf. *H. strigosa* group). *H. riparia*, which is often united with *H. stricta* (cf. Toelken 2010b), is more similar to *H. calycina*, but it is characterized by 5 to 7 subequal stamens and pronounced intrapetiolar tufts of simple hairs which are decurrent along the sides of the leaf bases. *H. riparia* occurs in Tasmania, southern Victoria and South Australia

Key to species and subspecies here referred to the *H. stricta* species-group

The primary bract often grades through a range of additional bracts into the subtending leaves, so that the bracts cannot be clearly distinguished from the leaves. The bracts in the *H. cistiflora* complex are therefore defined as those which resemble the uppermost bract (primary) and have an acute apex up to as long as the basal sheath is wide. In the *H. stricta* complex the bracts are distinguished from leaves only by their position subtending the flower, their relative size and the absence of revolute margins.

1. Ovary hairy; hairs on leaves without obviously raised tubercles
  2. Branches and calyx with simple hairs usually overtopping fascicled hairs, pubescent to hirsute . . . . . ***H. calycina***
  2: Branches and calyx with a range of only fascicled hairs, tomentose to hirsute, glabrescent or glabrous
    3. Calyx with scattered fascicled hairs (2–8 arms), rarely glabrescent
      4. Hairs on central upper leaf surface c. 0.1 mm long, with usually 3–5 arms; central vein of leaves touching revolute margins . . . . . ***H. stricta*** subsp. ***stricta***
      4: Hairs on central upper leaf surface c. 0.25 mm long, with (1) 2 or 3 arms; central vein of leaves usually not touching revolute margins . . . . . ***H. stricta*** subsp. ***furcatula***
    3: Calyx glabrous or with few hairs at the apex with a single arm
      5. Central vein of leaves distinctly recessed between revolute margins; flanks of leaves margins rounded . . . . . ***H. sulcinervis***
      5: Central vein of leaves bulging and overtopping revolute margins; flanks not as above . . . . . ***H. oxycraspedota***
1: Ovary glabrous; hairs on leaves with persistent tubercles
  6. Central vein protruding beyond apex of leaves up to 0.6 mm; Grampians, Victoria . . . . . ***H. cistiflora*** subsp. ***rostrata***
  6: Central vein not visibly overtopping leaf apex; New South Wales, central coast and tableland
    7. Stamens 6; leaves, at least below, with scattered tubercles . . . . . ***H. cistiflora*** subsp. ***cistiflora***
    7: Stamens 4 (5); leaves smooth or with tubercles along the margins and towards the apex . . . . . ***H. cistiflora*** subsp. ***quadristaminea***

***Hibbertia cistiflora* N.A.Wakef.**

Victorian Naturalist 72: 119 (1955); N.C.W.Beadle et al., Vasc. Pl. Sydney edn 2: 230 (1972); H.J.Willis, Handb. Victorian Pl. 2: 388 (1973); Hoogland, Austral. Syst. Bot. Soc. Newsletter 34: 4 (1983); G.J.Harden & J.Everett in G.J.Harden (ed.), Fl. New South Wales 1: 301 (1990); R.Carolin & M.Tindale, Fl. Sydney Region rev. edn.: 274 (1994); Toelken in N.G.Walsh & Entwisle (eds) 2: 307 (1996). — *Pleurandra cistiflora* Sieber ex Spreng., Linn. Syst Veg. edn 16 4(2) (Cur. Post.): 191 (Jan.–June 1827), nom. illeg. non *P. cistiflora* Reichb. (1825); G.Don, Gen. Hist. 1: 74 (1831); Steud., Nomencl. Bot. edn 2, 2: 354 (1841); Heyh., Nomencl. Bot. Hort. 2: 539 (1846). — **Typus:** "Nov. Holl.", *F.W.Sieber 148* (holo.: MEL1003802; iso.: G, K).

Pleurandra cistiflora Reichb., Iconogr. Bot. Exot. 1, t. 79 (1825) & xvii, 57 (Jan.–June 1827). — **Typus:** ?Iconogr. Bot. Exot. 1, t. 79.

Hibbertia stricta (R.Br. ex DC.) F.Muell. var. *glabriuscula* auct. non Benth.: Benth. Fl. Austral. 1: 27 (1863), p.p. as for the synonomy of *Pleurandra cistiflora*.

Shrublets to 0.3 m tall, little branched, erect, decumbent to slightly scrambling; branches wiry-woody becoming stiff-woody, up to 0.5 m long, with pronounced decurrent leaf bases ± flanged, glabrous. *Vestiture* mainly restricted to persistent tubercles but when young ± topped with fascicled hairs with 1 or 2 arms, scattered over leaves or on flanks of revolute leaf margins, rarely few non-persistent scattered simple hairs without tubercle on upper surface of leaves. *Leaves* without intrapetiolar tuft of hairs; *petiole* 0.2–1 mm long, ± flattened, often sharp-edged; *lamina* linear-elliptic to linear-lanceolate, (1.6–) 4–10 (–14.5) × 0.8–1.2 mm, bluntly acute, ± constricted into broad petiole, above flat to slightly concave and with scattered tubercles or glabrous except for a row of tubercles (rarely with 1 or 2 arms but wearing off soon) on flanks of the revolute margins, below slightly bulging central vein, but scarcely overtopping much narrower, and rarely dorsiventrally compressed, revolute margins, without undersurface being visible, tuberculate or glabrous, often clustered at the end of branches, distal ones spreading but subtending ones erect to almost appressed unless young actively growing plants. *Flowers* single, terminal on main and lateral branches; *peduncle* absent; *buds* ellipsoidal to ovoid; *primary bract* and usually 3 or 4 *additional bracts* usually not grading into subtending leaves, triangular to linear-triangular, 1.0–1.3 × 0.3–0.5 mm, acute to pointed, fleshy to scarious and without ridge or revolute margins, glabrous or with few hairs. *Calyx* not accrescent; *outer calyx lobes* oblong-elliptic to oblong-lanceolate, 4.5–5.1 × 1.9–2.2 mm, often longer than inner ones, acute to pointed, with or without central ridge but often folded apically, outside and inside glabrous; *inner calyx lobes* ovate to ovate-oblong, 4.2–4.5 × 2.3–2.6 mm, acute to cuspidate, and sometimes

Table 2. Characters of three species of the *H. stricta* species-group from the vicinity of Sydney.

Characters	*H. oxycraspedota*	*H. stricta* sens. str.	*H. cistiflora* subsp. *cistiflora*	*H. cistiflora* subsp. *quadristaminea*
Central leaf vein	bulging and overtopping revolute margins	bulging to flush with revolute margins	bulging to overtopping revolute margins	bulging to flush with revolute margins
Flanks of revolute leaf margins	sharp-edged	rounded	rounded or sharp-edged below flowers	± sharp-edged
Vestiture on stem	pubescent to glabrescent	pubescent, glabrescent	glabrous	glabrous
Vestiture on leaves	puberulous, with fascicled hairs with 1 (–3) arms	puberulous to glabrescent, with fascicled hairs with 3–5 arms	tubercles above and below, hairs with 1 or 2 arms but caducous	tubercles on flanks of margins
Vestiture on calyx	glabrous	pubescent	glabrous	glabrous
Intrapetiolar hairs	absent	up to 0.4 mm long	absent	absent
Bracts	(3) 4 oblong-triangular, scarious without revolute margins	1 linear to linear-elliptic, leaf-like with revolute margins	3–6 triangular-ovate scarious plus 3–5 linear, foliose with revolute margins	3 or 4, triangular-ovate scarious without revolute margins
Outer calyx lobes	smooth or apex ridged glabrous rarely few hairs	ridged pubescent, glabrescent	smooth, folded to hooded, glabrous	smooth, folded to hooded, glabrous
Anthers	6 (7) subequal 1.4–1.5 mm long	6 unequal, 2.3–2.5 mm, and 2.7–3.0 mm long	6 (7), subequal 1.8–2.1 mm long	4 (5), subequal 1.6–1.9 mm long
Ovary	pubescent ±lateral style attachment	tomentose apical style attachment	glabrous lateral style attachment	glabrous lateral style attachment

apically ridged, inside and outside glabrous. *Petals* broadly obovate, 4.5–12.4 mm long, bilobed. *Stamens* (7) 6 (5) or 4, subequal, in one cluster, *filaments* 0.4–0.8 (–1.2) mm long, usually scarcely, but sometimes up to half their length basally connate; *anthers* oblong-ovoid, 1.4–1.6 mm long, abruptly constricted above and below. *Pistils* 2; *ovaries* obovoid but ± laterally compressed, with 4 lateral ovules, glabrous; *style* dorso-laterally attached and curved up and erect to both sides of the anthers. *Fruit* obloid, glabrous. *Seeds* obloid-obovoid, 1.7–2.2 (–2.4) × 1.1–1.4, brown; aril with fleshy base surmounted by a ± lobed membranous cup covering the lower third to half of the seeds, often ± laterally attached.

Diagnostic features. *H. cistiflora* is easily distinguished from other species in the broad *H. stricta* complex by its glabrous ovaries with more or less laterally attached styles. Similar ovaries and styles have also been observed in the *H. acicularis* group, but those species are easily distinguished from this one by their sharply pointed leaf apices. Species of the *H. rufa* group have similar ovaries and are distinguished by their largely connate filaments.

Nomenclatural note. When Wakefield (1955) transferred the name of *Pleurandra cistiflora* to *Hibbertia*, he was only aware of the name published by Sprengel (1827) and did not refer to the earlier one by Reichenbach (1825). The two are, however, regarded as synonomous. Since Reichenbach did not mention in his protologue that his species is based on a Sieber collection, although it most likely was, Hoogland (1983) argued that it is based on a different type to that of the name Sprengel (1827) published. Sprengel's name is therefore an illegitimate later homonym, and Wakefield's new combination based on Sprengel's name in *Hibbertia* becomes a new name (Article 58, ICBN, McNeill et al. 2006). *Hibbertia cistiflora* N.A.Wakef. establishes its priority in *Hibbertia* and Reichenbach's name, the oldest for this taxon, can no longer be validly transferred into this genus.

Hibbertia cistiflora subsp. *cistiflora*

Shrublets with spreading to decumbent, rarely scrambling branches up to 1.4 m long. *Leaf lamina* (1.7–) 2.5–5 (–8.6) mm long, acute becoming obtuse with central vein scarcely protruding, above and below covered with scattered tubercles surmounted by fascicled hairs with 1 to 3 branches when young. *Flowers* terminal on main and lateral branches; *bracts* 1 or 2, surrounded by 3–5 linear-lanceolate additional ones. *Outer calyx lobes* ridged towards apex; *stamens* 6 or rarely 7 or 5; *anthers* 2–2.2 mm long. *Flowering*: mainly August–October but also occasional during the year. **Fig. 2M–O.**

Distribution and ecology. Recorded at Belrose, N.S.W., from ecotonal vegetation grading from heath comprised of *Angophora hispida*, *Banksia ericifolia*, *Allocasuarina distyla*, *Hakea laevipes*, *Leptospermum flavescens, Calytrix tetragona*, *Darwinia, fasicularis* and *Kunzea*

capitata to open forest-woodland of *Eucalyptus haemastoma, Corymbia gummifera* and *Banksia serrata* with shrubby understorey of above shrubs and *Leptospermum squarrosum*, *Hakea teretifolia*, *Petrophile pulchella*, *Persoonia pinifolius*, *P. lanceolata*, *Phebalium squamulosum*, Elsewhere recorded growing on sandy soil and/or sandstone in heath or shrubby vegetation in New South Wales (NC, CC).

Conservation status. This subspecies has been widely recorded.

Variation. Aside from the usual differences in the size of leaves and flowers with changing environmental conditions, it is the general appearance of plants in the field that greatly varies (*E.M.McBarron 17603*). Young plants are often spreading-erect but soon become decumbent or scrambling in surrounding shrubs and branches up 1.4 m have been recorded (*E.F.Constable NSW 26692*). The leaves on branches are usually not spreading and may become almost appressed, except that the distal leaves subtending the terminal flower are then spreading at a right angle to the branches. This gives the branch apex a tufted appearance and is accentuated on older branches where only a few distal leaves remain. Older plants have therefore a noticeably different appearance from younger ones or plants grown under favourable conditions.

The hair tubercles on the leaves are usually well developed on the flanks of the revolute margins, where often hairs with one or two branches are retained for a longer time, but tubercles are also prominent on the lower leaf surface. In some specimens the tubercles are less prominent on the lower leaf surface but usually some are observed, unlike in subsp. *quadristaminea*.

Selection of specimens examined (45 specimens seen)

New South Wales. **NC:** *J.Crawford CBG 43768*, Hawks Nest, ix.1972 (CANB). **CC:** *W.F.Blakely NSW 102093*, French Forest, vii.1911 (NSW); *W.F.Blakely NSW 102106*, Hornsby, vii.1916 (CANB, NSW); *J.L.Boorman NSW 102103*, Willoughby, vii.1917 (CANB, NSW); *E.F.Constable NSW 26692*, Mangrove Mountain, 5.vii.1951 (CANB, NSW); *R.D.Hoogland 12240*, 1 mile NE Mt White, 9.x.1972 (CANB); *L.Leichhardt NSW 102104*, North Shore, 24.vii.1842 (NSW); *E.M.McBarron 17603*, Woy Woy, Lookout, 25.viii.1969 (NSW); *R.Miller*, *J.Miller, A. & A.Peters s.n.*, Peats Ridge, Old Pacific Hwy, 26.iv.2010 (AD, NSW); *R.Miller*, *J.Miller & R.Peters 4a-d/28.viii.2010*, W Belrose substation, near Ralston /Elm Ave (AD, NSW); *R.Miller 138-144/23.x.2008*, Canoelands (AD); *J.Pulley 527*, Davidson Park, St Ives, 21.viii.1970 (CANB); *H.Salasoo 709*, Wahroonga, 11.viii.1951(NSW).

Hibbertia cistiflora* subsp. *quadristaminea* Toelken, *subsp. nov.

A subpeciebus aliis floribus 4 (5) antheris subequalis et tuberculis pilorum ad margines revolutes foliorum restrictis; a H. serpyllifolia *4 (5) antheris caespi dorsali differt.*

Typus: New South Wales, 2 miles SW Mt Wilson, *R.D. Hoogland 12245*, 10.ix.1972 (holo.: NSW 224327; iso.: MEL 572184; CANB, G, HBG; K, L, UC, US – n. v.).

Hibbertia cistiflora N.A.Wakef., Victorian Naturalist 72: 119 (1955), p.p.; N.C.W.Beadle et al., Vasc. Pl. Sydney edn 2: 230 (1972), p.p.; Hoogland, Austral. Syst. Bot. Soc. Newsletter 34: 4 (1983), p.p.; G.J.Harden & J.Everett in G.J.Harden (ed.) Fl. New South Wales 1: 301 (1990), p.p.; R.Carolin & M.Tindale, Fl. Sydney Region rev. edn.: 274 (1994), p.p.

Shrublets usually straggly, with erect-spreading to decumbent branches up to 0.4 m long. *Leaf lamina* (1.6–) 3–7.5 (–10.6) mm long, acute, above and below smooth except for a row of tubercles along the flanks of the revolute margins or rarely with a few tubercles towards the apex of the central vein. *Flowers* terminal on main and lateral branches; *bracts* 3 or 4, ovate, with 1 or 2 linear additional ones. *Outer calyx lobes* not ridged but often folded towards the apex; *stamens* 4, rarely 5; *anthers* 1.6–1.8 mm long. *Flowering*. August–October. **Fig. 2P, Q.**

Distribution and ecology. Grows sometimes locally common on dry sandy or gravelly slopes (of sandstone origin), but also often associated with seepage areas, with low heath often under open woodland of New South Wales (CT).

Conservation status. Locally common and conserved in the Blue Mountains National Park.

Diagnostic features. This taxon is often wrongly identified in herbaria as *H. serpyllifolia*, but subsp. *quadristaminea* has few stamens only in one dorsal cluster; it is also mistaken as *H. cistiflora* subsp. *cistiflora* but easily distinguished by the absence of fascicled as well as simple hairs on the stems. Subsp. *quadristaminea* is also distinguished from *H. stricta* s.s. and *H. oxycraspedota* by its glabrous ovary and usually 4 stamens (cf. Table 2).

Notes. Very few flowers with more than four stamens have been observed. They are normally stiffly erect and reminiscent of *H. rufa*, but lack the connate filaments. Nevertheless, the presentation of the stamens in both taxa is so similar that one is tempted to assume a similar pollination syndrome, in spite of very dry exposed habitats recorded for subsp. *quadristaminea*, while all species of the *H. rufa* group (cf. earlier) are found in swampy environments.

Wakefield (1955) and subsequent authors included this subspecies in the broader concept of *H. cistiflora*.

Etymology: The epithet ‘quadri-staminea’, Latin, ‘four-stamened’ refers to the flowers with predominantly four stamens in this subspecies.

Selection of specimen examined (39 seen)

New South Wales. **CT**: *C.Burgess CBG 5965*, Clarence, 10.x.1961 (CANB, BRI); *E.F.Constable NSW 48923*, Mt Blackheath, 21.x.1959 (CANB, NSW, BRI); *A.A.Hamilton NSW 102117*, Leura, 28.ix.1912 (NSW); *R.D.Hoogland 12247*, Mt Irvine, 11.ix.1972 (MEL, NSW; CANB, HBG, K, L, UC – n.v.); *R.D.Hoogland 12251*, NW side of Mt Banks, 11.ix.1972 (NSW; BRI, CANB, HBG, K, L, UC – n.v.); *R.D.Hoogland 12256*, between Linden and Woodford,

12.ix.1972 (CANB; HBG, K, L, NSW – n.v.); *L.A.S.Johnson NSW 102118*, Narrow Neck Peninsula, 29.ix.1945 (NSW); *H.K.C.Mair NSW 102122*, Mt Banks, 28.viii.1959 (NSW); *J.Rodway NSW 102123*, between Mt Tomah and Mt York, 18.x.1936 (NSW); *I.R.Telford 2924*, Blackheath, 28.ix.1971 (CANB); *H.R.Toelken 9522*, track above car park near Mini Hahafalls, 16.ix.2008 (AD, NSW).

***Hibbertia cistiflora* subsp. *rostrata* Toelken**

J. Adelaide Bot. Gard. 16: 60 (1995); Toelken in N.G.Walsh & Entwisle (eds), Fl. Victoria 3: 307 (1996). — **Type**: Victoria, c. 3 miles [4.8 km] S Goat Track, *R.D.Hoogland 11889*, 20.x.1970 (holo.:CANB; iso.: K, MEL, NSW; B, HBG, L, UC, US – n.v.).

Shrublets with spreading to scrambling branches rarely up to 1.5 m long. *Leaf lamina* (4–) 6–12 (–14.5) mm long, with pale beak (0.1–) 0.2–0.5 mm long consisting of the protruding central vein, smooth or with few tubercles towards the apex, rarely covered with blister-like tubercles. *Flowers* terminal on main and commonly on sessile lateral branches; *bracts* 3 or 4 surrounded by 2 or 3 additional ones subtending terminal flowers; 3–5 plus 2–4 additional ones below axillary flowers. *Outer calyx lobes* ridged towards apex; *stamens* 6; *anthers* 1.4–1.6 mm long. *Flowering*: mainly September–November. **Fig. 2S, T.**

Distribution and ecology. Endemic to the Grampians, Victoria (GR), where it grows on coarse sandy soil in heath to shrubby vegetation near summits or on ridgetops.

Conservation status. Conserved in Grampians National Park.

Notes. Populations from individual peaks vary with respect to the number of tubercles on the leaves (e.g. almost blister-like in *A.C.Beauglehole 30708*), the number of sessile axillary flowers and the number of bracts subtending them. The apices of the outer calyx lobes also vary from folded to hooded. All specimens examined of this subspecies are characterized by their pronounced apical beak of their leaves.

The large gap between the distribution of the two eastern subspecies and subsp. *rostrata* is also observed between *H. fumana* and *H. humifusa* (cf. *H. humifusa* group).

The leaves of a putative hybrid between this subspecies and *H. sericea*, a very rare phenomenon in *Hibbertia*, described by Toelken (2000, p. 39), are covered with long simple hairs over fascicled hairs, similar to those in *H. sericea.* However, unlike leaves of that species they are narrowly oblong with a very broad central vein obscuring the undersurface as in subsp. *rostrata*.

Selection of specimen examined (46 seen)

Victoria. **GR**: *R.Bates 6517*, Mt William, 11.xi.1985 (AD); *A.C.Beauglehole 30708*, Asses Ears, 22.v.1969 (AD, CANB, MEL); *T.B.Muir 2595*, Mt Rosea, 10.x.1962 (AD, MEL).

Hibbertia oxycraspedota* Toelken & R.T.Mill., *sp. nov.

A H. cistiflora *ovariis breve sericeis et marginibus petiolorum et laminarum foliorum complanatis et conflatis, veina centrali perprotuberanti; a* H. stricta *marginibus petiolorum et laminarum foliorum complanatis et conflates, antheris subequalibus differt.*
Typus: New South Wales: Mt Westmacott, Heathcote National Park, *R.T. & J. Miller 78*, 3.viii.2005 (holo.: AD; iso.: NSW).

Hibbertia stricta (R.Br. ex DC.) F.Muell. var. *glabriuscula* Benth., Fl. Austral. 1: 27 (1863), non *H. stricta var. glabriuscula* sensu J.M.Black (1926, 1952) (South Australia), nec *H. glabriuscula* Wheeler (1994) (Western Australia), nec *H. riparia* var. *glabriuscula* Hooker (1834) (Tasmania) (cf. *H. devitata* in Toelken 2010b). — **Typus**: "Fl. Novae Holl." *F.W.Sieber 150* (lecto. – selected here: K; iso.: MEL31619, MEL31620 (cf. typification).

Shrublet up to 0.4 m tall, more or less branched, spreading to decumbent; branches thin but stiff-woody, with pronounced decurrent leaf bases, ± shortly hairy to glabrescent. *Vestiture* persistent for some time, with few small subequal fascicled hairs on pronounced persistent basal tubercle; *on branches* sparse to usually moderately dense, to glabrescent, with spreading fine multiangulate fascicled hairs ((1) 2–5 (–9) subequal or unequal arms); *on leaves above* sparse, with scattered fascicled hairs (with 1 or 2 subequal antrorse arms) on pronounced persistent basal tubercle becoming larger towards and on the sharp edge of the flanks of the revolute margins; *on leaves below* with fewer and often shorter antrorse hairs as above; *on bracts and calyx* glabrous or rarely with few short simple hairs (rarely forked) without tubercles towards the apex. *Leaves* without intrapetiolar tuft of hairs; *petiole* 0.2–0.5 (–0.8) mm long, flattened, sharp-edged; *lamina* linear-triangular or -lanceolate, (4.6–) 5.4–6.5 (–7.2) × (0.4–) 0.5–0.8 (–1.1) mm, acute with short hairs, usually scarcely constricted into broadened petiole, above flat and puberulous to glabrescent, below with bulging central vein overtopping (partly overlaying) dorsiventrally compressed revolute margins, without undersurface being visible, glabrescent. *Flowers* single, terminal mainly on main branches but also on axillary short shoots; *peduncle/pedicel* absent; *buds* ellipsoidal; *bracts* 1 to several grading into the subtending leaves, linear to linear-triangular, 2.8–3.4 × 0.4–05 (–0.6) mm, bluntly acute to obtuse, scarcely ridged, glabrous or with few faint hair tubercles at the apex. *Calyx* not accrescent; *outer calyx lobes* lanceolate, (4.8–) 5.2–5.8 × (1.3–) 1.5–1.8 mm, often slightly shorter than inner ones, acute, without central ridge, outside glabrous or with few appressed hairs towards the apex, inside glabrous; *inner calyx lobes* ovate, 5.1–5.8 × (2.0–) 2.3–2.8 mm, acute, with membranous margins, glabrous. *Petals* obovate, 5.2–6.3 mm long, bilobed. *Stamens* (5–) 7 (very rarely 3–4), subequal, in one cluster; *filaments* 0.6–0.9 (–1.1) mm long, basally connate; *anthers* obloid, (1.9–) 2.0–2.2 mm long, abruptly constricted above and below. *Pistils* 2; *ovaries* obovoid but slightly laterally compressed, with 4 lateral ovules, shortly ± sericeous or

with short antrorse appressed hairs, style dorso-laterally attached and erect with stigmas just above the apex of the anthers. *Fruit* and *seeds* not seen. *Flowering*: August–October, but also some records throughout the year. **Fig. 2U–X.**

Distribution and ecology. Grows on sandy soil on sandstone but often on seepage areas in New South Wales (CC).

Conservation status. Locally frequent in Budawang National Park (*H.R.Toelken 8418*).

Diagnostic features. *Hibbertia oxycraspedota* was usually included in the very similar *H. cistiflora*, because of the reduced fascicled hairs on leaves and especially the laterally compressed ovaries and more or less laterally attached styles. However, unlike *H. cistiflora*, the margins of the petiole and leaf lamina are sharp-edged, the leaf lamina is usually shorter, the bulging central vein of leaves is overlaying parts of the flattened revolute margins (so that there is no groove between the two), the usually six or seven stamens have shorter anthers (1.4–1.5 mm long), and the ovary is usually densely covered with antrorse appressed hairs. *Hibbertia oxycraspedota* has also similar hairy ovaries to *H. stricta* s.s. (cf. Table 2) but is mainly distinguished by its broad central vein overtopping the revolute ungrooved margins, the sharp-edged leaf lamina and petiole, and the centrifugal stamens are scarcely longer, but their anthers are not significantly longer than in *H. stricta* s.s.

Variation. Hair presence, particularly on the branches, varies from almost absent to moderately dense on other specimens.

The habit varies from commonly erect with tufts of leaves terminal on all branches to spreading (usually in young plants) with leaves covering all branches, but these leaves are more or less appressed and tufted distally.

The number of stamens is usually 6 or 7, but occasional flowers with 3 or 4 stamens can be observed. One collection, *R.T. & J.Miller 18a–g/30.x.2010*, has most flowers with 3 or 4 stamens and beaked outer calyx lobes, but other plants of that general location are normal (*R.T. & J.Miller 71/30.x.2010*).

Typification. When Bentham (1863) published *H. stricta* var. *glabriuscula* he included in "the commonest forms" specimens of *Sieber 150*, *151*, *147* and *148*, but conceded that only the first two agreed most closely with his concept. Among the first two Sieber collections, plants of *Sieber 150* are less glabrous so that the specimen of that collection at Kew Herbarium, annotated by Bentham in red pencil, was selected as the lectotype.

Etymology. The epithet 'oxy-crasped-ota', Latinised Greek, 'possession of sharp-edged or sharp-margined' leaves refers to the pronounced dorsiventrally compressed petiole and revolute margins of the basal leaf lamina characteristic of the species.

Specimens examined

New South Wales. **CC:** *C.Barnard CANB 6065*, Sublime Pt, ix.1941 (CANB); *R.Coveny 6634 & J.Powell*, Uloola Track, Royal National Park, 21.viii.1975 (NSW); *A.Fairley s.n.*, Dharawal Nat. Park, 22.ix.2001 (AD, NSW); *R.D.Hoogland 12216*, along Appin Road, 5.ix.1972 (CANB, NSW; E, HBG, L, UC – n.v.); *R.T.Miller 74*, French Forest, 10.iii.2007 (AD, NSW); *R.T.Miller s.n.*, Madden Plains, E old Princes Highway, 6.vi.2007 (AD); *R.T. & J. Miller 35A, B/3.x.2010*, Madden Falls (AD, NSW); *R.T. & J.Miller 18a–g/30.x.2010*, Wandean Road (AD, NSW); *R.T. & J.Miller 25h-l/30.x.2010*, Wandean Road (AD); *R.T. & J.Miller 71/30.x.2010*, Wandean Road (AD); *I.R.Telford 2981*, Princes Highway–Darks Forest Road, S Helensburgh, 30.ix.1971 (CANB). **SC**: *L.G.Adams & K.Paijmans 3780*, 5 km SSE Mt Tianjara, 26.iii.1981 (CANB); *E.F.Constable NSW 45265*, Turpentine Range, c. 15 miles S Nowra, 27.x.1957 (NSW); *J.Pickard 1667*, 1.35 km ESE Nerriga, 5.ix.1971 (NSW); *R.Pullen 4853*, c. 1.6km N Pigeon House Mountains, W Ulladulla. 29.vi.1973 (CANB); *R.Pullen 4971 & J.Story*, N. side of Mt Corang, 26.ix.1973 (NSW; CANB – n.v.). *J.Pulley CBG 8008198*, Little Forest Plateau, NW Milton, 21.vi.1973 (CANB); *J.Pulley 176*, near Great Natural Bridge, 21.ix.1971 (CANB); *H.R.Toelken 8413*, Wog Wog camping area, 31.x.1993 (AD, NSW); *H.R.Toelken 8418*, below summit of Mt Corang, 31.x.1993 (AD, NSW).

***Hibbertia stricta* (R.Br. ex DC.) F.Muell. sens. str.**

Pl. Indig, Col. Vict. 1: 15 (1862), p.p.; Benth. Fl. Austral. 1: 27 (1863), p.p.; F.Muell., Syst. Cens. 1: 1 (1882), p.p.; F.M.Bail., Syn. Queensl. Fl. 4 (1887), p.p.; N.C.W.Beadle et al., Vasc. Pl. Sydney edn 2: 230 (1972), p.p.; H.J.Willis, Handb. Victorian Pl. 2: 388 (1973), p.p. — *Pleurandra stricta* R.Br. ex DC., Syst. Nat. 1: 422 (1817); DC., Prodr. 1: 73 (1824); Spreng., Syst. Veg. edn 16, 4(2) (Cur. Post.): 191 (1827); G.Don, Gen. Hist. 1: 74 (1831), as 'striata'; Schldl., Linnaea 20: 625 (1847), p.p. — *Pleurandra riparia* DC. var. *stricta* (R.Br. ex DC.) Hook.f., Fl. Tasm. 1: 17 (1855), p.p. — **Typus**: New South Wales, near Port Jackson, *R.Brown* [*J.J.Bennett 4877*] (holo.: G-DC; iso.: BM, K?, MEL35934, MEL35942).

Hibbertia riparia auctt. non (DC.) Hoogland: Hoogland, Kew Bull. 29: 155 (1974), p.p., quoad *H. stricta*; Jessop in Jessop & Toelken (eds), Fl. S.Austral. 1: 357 (1986), p.p.; G.J.Harden & J.Everett in G.J.Harden (ed.), Fl. New South Wales 1: 301 (1990), p.p.; R.Carolin & M.Tindale, Fl. Sydney Region rev. edn.: 274 (1994), p.p.; Toelken in N.G.Walsh, & Entwisle (eds), Fl. Victoria 3: 312 (1996), p.p.

Shrublet rarely up to 0.6 m tall, with several erect branches moderately to densely branched; branches wiry becoming stiff-woody, with decurrent leaf bases often becoming flanged, puberulous to pubescent, rarely shortly hirsute. *Vestiture* persistent to glabrescent, with slightly larger over smaller fascicled hairs on branches, bracts, calyx and on leaves, often reduced to ones with single arms; *on branches* moderately to dense, rarely sparse, larger (with usually (3–) 5–9 subequal arms) over smaller fascicled hairs (1–4 subequal arms) mainly between leaf bases; *on leaves above* sparse to dense, with mainly larger ((1) 2–5 subequal arms, becoming more towards the margins) over few smaller fascicled hairs (1–3 usually subequal arms); *on leaves below* similar to above but usually somewhat larger and denser; *on bracts* similar to leaves but often with arms

± antrorse and marginal one become cilia-like; *on outer calyx lobes* outside dense to scattered larger fascicled hairs on tubercles (6–8 subequal, rarely unequal arms) sometimes concentrated along the centre over smaller ones (3–5 subequal to uneven arms), inside dense to sparse, with fine antrorse fascicled hairs without tubercles on the upper half; *on inner calyx lobes* outside usually dense, with larger fascicled hairs over smaller ones and all becoming gradually shorter towards the membranous margins, inside with few fine forked hairs at the apex. *Leaves* with intrapetiolar tuft of hairs 0–0.2 mm long; *petiole* 0.2–1.1 mm long, with rounded margins often indistinct from lamina; *lamina* linear, (2.3–) 6–12 (–23.5) × (0.2–) 0.4–0.6 (–0.8) mm, acute or pointed, often becoming obtuse, gradually and usually scarcely constricted into petiole, above flat to somewhat rounded, puberulous, pubescent to glabrescent, below with central vein bulging and often overtopping scarcely narrower revolute margins, without undersurface being visible, puberulous, pubescent, shortly hirsute to glabrescent. *Flowers* single, terminal mainly on distal main branches or axillary branches or short shoots; *peduncle and pedicel* absent; *buds* narrowly ovoid to ellipsoidal; *primary bract* linear-triangular, (1.9–) 2.2–3 (–3.4) × 0.2–0.3 (–0.4) mm, acute, fleshy, pubescent to glabrescent; additional bracts similar but merging into linear leaves. *Calyx* not accrescent; *outer calyx lobes* ovate to lanceolate, (4.3–) 4.8–5.5 (–6) × (1–) 1.2–1.5 mm, often longer than inner ones, acute to beaked, with central ridge down to centre, outside puberulous to pubescent or shortly hirsute, rarely glabrescent, inside puberulous to pubescent on the upper half; *inner calyx lobes* ovate to oblong-ovate or elliptic, (4.3–) 4.5–5 (–5.5) × (1.8–) 2–2.3 mm, sometimes slightly ridged, outside puberulous to pubescent along the central ridge, inside glabrous. *Petals* cuneate-obovate, 4.5–7.3 mm long, emarginate to bilobed. *Stamens* 6 or 7, with central one distinctly longer, *filaments* 0.8–1.5 mm long; *anther* obloid-obovoid, 1–1.5(–1.8) mm long or longer one 1.8–2.5 mm long, abruptly constricted above and below. *Pistils* 2: *ovaries* broadly obovoid, scarcely laterally constricted, with 4 lateral ovules, tomentose; *style* attached terminally or sometimes laterally to the ovaries, then the styles down- and backwards before straight upwards on both sides of the anthers and with stigmas well above the apex of the anthers. *Fruit* tomentose to puberulous. *Seeds* obloid to obloid-obovoid, 1.8–2.1 × 1–1.3 mm, black; aril with fleshy base surmounted by a membranous cup with 1–3 irregular spreading lobes, often longer than the base and clasping the lower third of seeds.

Diagnostic features. *Hibbertia stricta* cannot be distinguished from each of the species included in the *H. stricta* group by a single character, but rather by a combination of a number of different characters (Table 2). Similarly, it differs by multiple character states from other groups of species segregated from Bentham's very broad concept (Toelken, in prep.). The most reliable characters being: leaves usually with broad bulging central vein, only fascicled hairs on branches and calyx, sessile flowers usually with several bracts merging into subtending leaves, outer calyx ridged at least on the distal half, ovary tomentose.

H. devitata Toelken (2010b) differs from *H. stricta* s.s. by its distinctive leaves with an excessively bulging central vein so that it starts overlaying the revolute margins. The anthers are also rarely more than 1.8 mm long, while in *H. stricta* they are usually longer.

Taxonomic notes. The very broad delineation of *H. stricta* by Bentham (1863) seems to be largely based on the extraordinary agglomeration of synonyms of previously published species under that name by Mueller (1862). This in turn might have been influenced by the treatment J.D.Hooker (1855) provided of the Tasmanian representatives of this group. Mueller, however, included *H. empetrifolia*, now in the *H. aspera* group, and *H. enervia* (cf. Toelken 2004), now relegated to the *H. fasciculata* group (Toelken, in prep.). Bentham's broad concept was maintained in Australian literature except for a fleeting start to a reassessment of some taxa by Wakefield (1955). Hoogland (1974), however, rearranged a similar synonomy to Bentham's, but now under *H. riparia*. He made these changes following Hooker (1855), who was the first to include *H. stricta* under *H. riparia*. Since *H. riparia* and *H. stricta* were established in the same publication, Hooker's choice has priority (article 11.5, ICBN, McNeill et al. 2006).

The interpretation of *H. stricta* s.s. has not only varied because of Bentham's very broad concept, but also, because different type specimens were distributed to various herbaria. Robert Brown's manuscript description of *Pleurandra stricta* is based on the specimen: "In campis arenosia prope Sullivan Bay nr Port Phillip" (e.g. MEL 695599), which, on the basis of its stalked flowers, is now referable to *H. australis* (cf. Toelken 2010b). But Brown's manuscript description states "Flores terminales solitarii sessiles erecti". However, when and why the type specimen was changed is not known, as de Candolle (1817) clearly describes in the protologue "flores ad ramorum apices solitarii sessiles" and "Hab. In Nova-Hollandia prope Port Jackson" (e.g. G(DC), MEL 35934, MEL 35942). The specimen MEL 35942 and a specimen in the British Museum are annotated "R.Brown [J.J.Bennett 4877] in arenosis inter Sydney + Botany Bay" and the latter (in BM) bears the manuscript name "*Pleurandra arenaria*", a name that was never taken up. All these latter specimens, i.e. including the holotype from the Sydney area, agree in all respects with the protologue and represent quite a different species to the one Brown originally described. This interpretation of *H. stricta* s.s. is adopted here.

Hibbertia stricta* subsp. *stricta

Pleurandra microphylla Sieber ex Spreng., Syst. Veg. edn 16, 4(2) (Cur. Post.): 191 (1827); G.Don, Gen. Hist. 1: 74 (1831); A.DC., Linnaea 25: 577 (1853); non *Hibbertia microphylla* Steud. (1845) (Western Australia), nec

Pleurandra riparia var. *microphylla* J.D.Hook. (1855) (Tasmania). — **Typus**: "Fl. Novae Holl.", *F.W.Sieber 143* (holo.: W – n.v.; iso.: G, K).

Leaves usually with short and coarse fascicled hairs with arms up to 0.1 mm long, deciduous and with a tubercle, above along the centre hairs with 3–5 arms or if less then arms very short and reduced, rarely completely absent, below with revolute margins touching often bulging central vein and undersurface not visible between them. *Flowering*: August–November. **Fig. 2D–G.**

Distribution and ecology. Grows on sandy soil of often old sand dunes or derived from sand stone, in heath mainly in low-lying areas along the coast of New South Wales (CC, SC).

Conservation status. Locally frequent in conserved areas (e.g. *H.R.Toelken 9514*).

Variation. *Hibbertia stricta* shows much variation even of the fascicled hairs, which have usually equally long arms. In var. *stricta* they are usually subtended by a tubercle, which does not rise as abruptly as those of *H. cistiflora*. The uneven leaf surface, particularly on the flanks of the revolute margins on older leaves where the hairs have worn off, is always noticeable. Furthermore, the number of arms of individual hairs varies considerably and in many forms it is smaller, but then the arms are shorter. Among these there are often hairs with a single arm, but since it is situated on a tubercle it is here interpreted as a fascicled hair in contrast to those simple hairs (e.g. as on *H. calycina)*, which have a different texture and no basal tubercle.

Similar to younger plants of *H. cistiflora,* branches of *H. stricta* are covered with leaves, but on older plants the leaves are clustered at the apex. These leaves are more or less similarly spreading or more erect on the same plant unlike the tufted effect with much more spreading distal leaves in *H. cistiflora*. The width of the central vein also varies in relation to the width of the revolute margins and is the amount of bulging, but rarely is it starting to overlie the revolute margins, as it is typical of leaves of *H. devitata*.

The outer calyx lobes are usually acuminate and longer than the inner ones in the Central Coast Region, while they are acute and about as long as the inner ones along the Southern Coast. Along similar regions some local variation of terminal to a more or less lateral style attachment was observed, but all the above variants could not be clearly distinguished.

Notes. The identity of *Pleurandra microphylla* caused some uncertainty, because Sprengel (1827) referred to Sieber, but did not cite the number of the collection on which it is based. A. de Candolle (1853) corrected this by placing it in *H. stricta*, based on *F.W.Sieber 143* (not *F.W.Sieber 151*, which is a glabrescent specimen of *H. stricta* subsp. *stricta*). *Pleurandra microphylla* is more hairy, as indicated in the original description of the species. The specific epithet '*microphylla*' does not contribute to the identification, as, for instance, a *Sieber* specimen identified as *P. microphylla* (MEL 1003805), is actually a small-leaved form of *H. cistiflora* similar to *F.W.Sieber 148*. Wakefield (1955) also reached a similar conclusion, but then associated this depauperate specimen of *H. stricta* (*P. microphylla*) with the western form, much of which is here considered to be *H. devitata*. The latter is easily distinguished by its excessively bulging central vein of the leaves.

Selection of specimens examined (46 seen)

New South Wales. **CC:** *E.Cheel NSW 101882*, Bondi, 28.viii.1898 (NSW); *R.G.Coveny NSW 101869*, Kangaroo Creek, Royal National Park, 2.viii.1966 (NSW); *Froggatt NSW229713*, Botany Bay, 28.ix.1894 (AD, MEL; NSW – n.v.); *C.P.Gibson & R.T.Miller 47/1.xi.2006*, Picnic Point, eastern Yeramba Lagoon (AD, NSW); *C.P.Gibson 48/5.x.2006*, Picnic Point, eastern Yeramba Lagoon (AD); *F.W.Sieber 151*, "Nov. Holland." (MEL35936); *C.L.Wilson 487*, South Coogee sand hills, 21.iii.1957 (NSW). **SC:** *E.Gauba NBG4791*, Jervis Bay, 16.ix.1951 (BRI, CANB); *R.D.Hoogland 12267*, S Lake Wollumboola along Nowra–Currarong road, 14.ix.1972 (BRI, NSW; CANB, E, HBG, K, L – n.v.); *K.O'Ryan 50 & R.Windsor*, 15 km E Tiantjara Falls, 13.viii.1984 (AD, CANB – n.v.); *J.Pulley NBG 43380*, Ulladulla, 13.1.1969 (CANB); *J.Taylor 1251, J.Rymer & R.Jackson*, Bowen Island, 4.xii.1980 (CANB); *H.R.Toelken 9514*, Cape Jervis, 200m from gates, 5.ix.2008 (AD, NSW).

Hibbertia stricta* subsp. *furcatula* Toelken, *subsp. nov.

A subspecie typica pilis fasciculatis in paginis superis foliorum circiter 0.2 mm longis et (1) 2 vel 3 furcatis nervisque centralibus foliorum non continguis margines revoluta differt.

Typus: New South Wales, Dilkara Court, Menai, *A. Fairley s.n.*, i.2005 (holo.: AD; iso.: MEL, NSW).

Hibbertia sp. Menai (A.T.Fairley 15 Dec. 2004) N.S.W. Herbarium in PlantNet Flora of New South Wales Online (2005).

Leaves with fascicled hairs with fine arms c. 0.2 mm long, persistent and without a tubercle, above usually bifurcate, rarely trifurcate along the centre of the upper surface, below with distinct gap showing the hairy undersurface between revolute margins and the central vein. *Flowering*: September–December (February). **Fig. 2H, I.**

Distribution and ecology. Grows in gravelly loam or clay soil in heath under open woodland on the central coast of New South Wales (CC, SC).

Conservation status. Apparently rare, but one population conserved in Royal National Park (*H.R.Toelken 9506*).

Variation. Plants show similar variation to the typical subspecies, but the hairs are always relatively long and erect-spreading.

Etymology. The epithet 'furcatula', Latin, 'little fork' is derived from the fine forked fascicled hairs along the centre of the upper surface of the leaves which are characteristic of this subspecies.

Specimens examined

New South Wales. **CC:** *J.H.Camfield NSW 101887*, Oatley, xi.1901 (NSW); *J.H.Camfield NSW 101892*, Loftus, i.1894 (NSW); *J.J.Fletcher NSW 101888*, Como, 6.iii.1887 (NSW); *H.R.Toelken 9506*, Chinamans Helipad, Royal National Park, 4.ix.2008 (AD, NSW). **SC:** *E.F.Constable NSW 16620*, Nowra North, 8.xii.1950 (NSW); *E.F.Constable NSW 51016*, west of Nowra on Bamerang road, 26.ii.1960 (NSW).

Hibbertia sulcinervis* Toelken, *sp. nov.

H. strictae *affinis sed foliis longioribus ((7.4–) 10–20 (–34.5) mm longis) et nervis sulcatis caliceque glabro; a* H. cistiflora *ovario pubescente vel hirsute et nervis foliorum sulcatis; a* H. oxycraspedota *marginibus foliorum et petiolis rotundatis nervisque foliorum sulcatis differt.*

Typus: New South Wales, Nortons Basin, *R.G.Coveny NSW102007*, 18.xii.1965 (holo: NSW).

Shrubs up to 0.6 m tall, with a number of erect, moderately branched, stiff main branches; branches stiff-woody, with pronounced ± flanged leaf bases, puberulous or glabrous on leaf bases. *Vestiture* persistent to glabrescent, fascicled hairs often reduced to a single arm or pale tubercle; *on branches* persistent, moderately dense to glabrescent or usually glabrous on raised leaf bases, with subequal short fascicled hairs (with (1–) 3–5 subequal arms) and with short intrapetiolar tuft; *on leaves above and below* glabrous and without hair bases as in *H. stricta* but with few fascicled hair with 1–3 arms on the margins of the petiole; *on bracts* persistent, minute scattered fascicled hairs with 1 (2) arms mainly along the margins; *on outer and inner calyx lobes* glabrous but often with papillae on pointed apex of outer ones. *Leaves* with short intrapetiolar tufts 0.2–0.3 mm long; *petiole* (0.5–) 0.8–1.6 mm long, with incurved edges; *lamina* linear, (7.4–) 10–20 (–34.5) × 0.8–1.1 (–1.3) mm, acute to pointed and with short hairs when young, scarcely constricted into petiole, above flat and glabrous, below broad central vein distinctly recessed between bulging revolute margins with few scattered hairs (with 1 deciduous arm without tubercle) when young without undersurface being visible. *Flowers* terminal distally on main and axillary branches or short shoots; *pedicel* up to 2 mm long; *buds* narrowly ovoid or ellipsoidal; *primary bract* linear-triangular to linear-elliptic, (1.2–) 1.6–2.3 × 0.2–0.3 mm, acute, fleshy and without basal sheath, caducous; *additional bracts* similar but merging into linear leaves. *Calyx* not accrescent; *outer calyx lobes* lanceolate, 45–5.5 (–6) × 1.8–2.2 mm, sometimes slightly longer than inner ones, with faint central ridge down to at least the centre, outside and inside glabrous or with few deciduous small hairs; *inner calyx lobes* elliptic-ovate to elliptic, 4.5–5.3 (–5.5) × 2.2–2.8 mm, scarious with membranous margin, without ridge, outside and inside glabrous. *Petals* cuneate-obovate, 4.2–5.8 (–7.4) mm long, emarginate. *Stamens* 6 or 7, with central one longer, in one cluster; *filaments* 0.9–1.1 mm long, basally connate; *anthers* 1.5–1.7 mm long or longer one 1.8–2.2 mm long, abruptly constricted above and below. *Pistils* 2; *ovaries* broadly obovoid but somewhat laterally compressed, with 4 lateral ovules, shortly hirsute; *style* ± laterally attached, then recurved and erect on both sides of the anthers, with stigmas well above the apex of the anthers. *Fruit* and *seeds* unknown. *Flowering*: September–December. **Fig. 2J–L.**

Distribution and ecology. Ecology unknown, except for its occurrence at Norton Basin along the Nepean River, New South Wales (CC).

Conservation status. Only two collections of this species are known, from 1898 and 1965. It is possibly extinct.

Diagnostic features. *H. sulcinervis* is distinguished from *H. stricta* by its long leaves ((7.4–) 10–20 (–34.5) mm long) each with an obviously recessed central vein and without showing the undersurface. In addition, it has glabrous or almost glabrous calyces (sometimes with few short hairs at the apex of the outer calyx lobes). The hairy ovary and strongly recessed central vein of leaves distinguishes it from *H. cistiflora*. It differs from *H. oxycraspedota* by the rounded margins of the leaves and their recessed central vein.

Variation. In spite of its recessed central vein the undersurface of the leaves was not seen in the two dried specimens examined.

In contrast to the very similar *H. stricta* the leaves of *H. sulcinervis* do not show pale spots (not tubercles as in *H. cistiflora*) where hairs had been attached to the surface. However, occasionally some unevenness of the margins of the leaves could indicate that these hair bases might be observed in fresh material or in a larger range of material of the species.

Etymology. The epithet 'sulcinervis', Latin, 'with grooved nerves' refers to the characteristic central vein of the leaves, which is distinctly recessed below the revolute margins to form a well-defined groove.

Specimen examined

New South Wales. **CC:** *W.Forsyth NSW 102009*, Nepean River, ix.1898 (NSW).

7. *H. strigosa* Toelken group

Specimens identified by Bentham (1863) as *H. stricta* var. *hirtiflora* Benth. are here largely referred to the *H. strigosa* group. It is mainly found west of the Great Dividing Range in Queensland, New South Wales and northern Victoria.

Species resemble those of the *H. stricta* group, as they also have sessile flowers subtended by several bracts. But they are distinguished by long, usually coarse, forked to simple hairs, which are more or less appressed (strigose) to the calyx and often overtopping short fascicled hairs, well developed intrapetiolar tufts of hair in the leaf axils, especially below the flowers, and usually more than 10 stamens with narrow subequal anthers.

The long hairs on the calyx often leads to confusion with the *H. sericea* group (cf. earlier), which is, however,

easily distinguished by the recurved distal margins and terminal ridge of the outer calyx lobes, together with single terminal flowers, or, if the flowers are distally clustered, then usually in a corymbiform inflorescence; this is in contrast to the spikiform arrangement common in the *H. strigosa* and *H. stricta* groups. Flowers of species of the *H. strigosa* group also resemble those of the *H. cistoidea* group (Toelken, in prep.), but are sessile and usually with several bracts; the outer calyx lobes of *H. strigosa* and relatives are usually lanceolate and generally more than 10 slender stamens are present.

Hibbertia strigosa Toelken, *sp. nov.*

A H. calycina *absentia pilorum simplicum in ramis, lobis calicis longioribus (6.8–9.2 mm) cristisque ad basim differt.*

Typus: Victoria, 5.5 miles NNW Myrtleford, *A.C. Beauglehole 43777 & D.G.Cameron*, 7.xii.1973 (holo.: MEL119617; iso.: CANB288725, NSW241887).

Hibbertia calycina (DC.) N.A.Wakef., Victorian Naturalist 72: 122 (1955), p.p.; Willis, Handb. Pl. Victoria 2: 389 (1973), p.p.; Toelken in N.G.Walsh & T.Entwisle (eds), Fl. Victoria 2: 307 (1996), p.p..

Shrubs up to 0.5 m tall, more or less untidily branched, erect to spreading; branches slightly ridged to sparsely flanged from the decurrent leaf bases, fascicled-tomentose. *Vestiture* ± persistent, with moderately to sparsely dense little-branched fascicled hairs, rarely glabrescent and with long simple to forked hairs on the calyx; *on branches* sparsely to moderately dense with short erect-spreading fascicled hairs (4–6 subequal to unequal arms) overtopping fewer even smaller ones (2–3 usually unequal arms), rarely with few simple hairs decurrent from the leaf axils along groove on either side of leaf bases; *on leaves above* sparse to glabrescent, with short antrorse-appressed fascicled hairs ((1) 2 or 3 often unequal arms) becoming longer and usually tuberculate towards the margins; *on leaves below* sparse and scattered on revolute margins, with antrorse-appressed, usually tuberculate fascicled hairs ((1) 2 or 3 usually unequal arms), glabrous or only tubercles on the central vein; *on bracts* dense but similar to leaves except marginal fascicled hairs are spreading-ciliate; *on outer calyx lobes* outside dense, with fine long simple hairs along the centre becoming shorter and usually biforked towards the margins and usually overtopping few small erect-spreading fascicled hairs (4–6 subequal arms) towards the base, inside moderately dense, with fine shorter antrorse-appressed, usually biforked hairs on the upper half to third; *on inner calyx lobes* outside dense, with fine long simple hairs along the central ridge becoming shorter and commonly biforked to glabrescent on the membranous margins, inside, sparse to glabrous, with few short antrorse-appressed simple hairs, rarely forked towards the apex. *Leaves* with tufts of simple hairs in leaf axils but also continued on base of upper (adaxial) leaf surface; *petiole* 0.2–0.6 mm long, often indistinct; *lamina* linear, rarely linear-lanceolate, (5.4–) 10–16 (–23) × (06–) 0.8–1.2 (–1.4) mm, scarcely tapering into petiole, acute to pointed, above flat to slightly convex puberulous, below with central vein usually twice broader than the revolute margins at mid-leaf and recessed to flush, puberulous to glabrescent. *Flowers* single and terminal to clustered into distal spikiform inflorescence, sessile or subsessile on main and short lateral branches; *buds* narrowly ovoid; *primary bract* linear-triangular, 3.6–4.4 × 0.3–0.45 mm, shorter than calyx, acute, leaf-like with revolute margins, pubescent below, above sparsely so, caducous to deciduous; up to 5 additional bracts merging into leaves. *Calyx* lobes similar; *outer calyx lobes* oblong-lanceolate, (6.8–)7.5–8.5 (–9.2) × 3.1–3.5 mm, subequal to slightly longer than inner ones, acute, stiffly ridged from the base but often obscured by strigose tomentum, inside sparsely hairy on upper third to half; *inner calyx lobes* oblong-lanceolate to -elliptic, (7–) 8.2–8.9 × 3.6–4.3 mm, acute, usually stiffly ridged from base, outside shortly strigose, inside with few hairs on the upper margin. *Petals* broadly obovate, 9–11.8 mm long, emarginate to biblobed. *Stamens* (9–) 12–14 (–16), in dorsal cluster; *filaments* slender, 3–3.4 mm long, with one somewhat longer; *anthers* slender, obloid, 2.1–2.4 mm long, subequal, straight, scarcely constricted above and below. *Pistils* 2; *ovaries* obloid-obovoid, each with 6 (–8) ovules above one another, strigose with few arms to fascicled hairs; *style* base attached to apex of ovary and curved sideways on side of stamens and covered with scattered fascicled hairs, with styles straight erect next to stamens and with stigma well above them. *Fruits* erect. *Seeds* ovoid, 2–2.4 × 1.8–2 mm, brown to black; *aril* with fleshy base surmounted by membranous cup, slightly lobed to one side and covering the lower third to half of the seed. *Flowering*: October–December. **Fig. 2A–C.**

Distribution. Grows on sandy loams or sandy soils in open woodland of south-west New South Wales (SWS) and north-eastern Victoria (EHL), where it is reported from *Eucalyptus sieberi* open forest with *Acacia obliquinervia*, *Cassinia longifolia*, *Monotoca scoparia*, *Joycea pallida*, *Persoonia confertiflora*, *Pultenaea scabra* and *Davesia latifolia* (*N.G.Walsh 5614*).

Conservation status. Locally common (*N.G.Walsh 5614*).

Diagnostic features. *Hibbertia strigosa* is very similar to *H. calycina*, but unlike that species, it has no simple hairs on the stems, which are covered with small fascicled hairs and the calyx lobes are longer. The calyx lobes exhibit a pronounced ridged central vein towards the base of each lobe, in contrast to the *H. sericea*, *H. stricta* and *H. cistoidea* groups, where the veins, if present, are more defined on the upper half of the lobes.

Variation. Although plants in general have spreading pointed leaves and appear pungent, they are not awned as in the case of *H. acicularis* group. This is particularly impressive in young plants, which have at times

exceptionally long leaves. The hairs on the leaves are always antrorse but in plants from Victoria they have short arms, which sometimes wear off. Some plants in New South Wales are more densely hairy and also the arms are longer (e.g. *N.T.Burbidge 488*).

Notes. A "strong off-sweet odour" was recorded by *R.Bates 11140*, *11170*.

Etymology. The epithet 'strigosa', Latin, 'strigose' refers to the type of tomentum with long stiff antrorse and more or less appressed hairs on the calyx.

Specimens examined

New South Wales. **SWS:** *R.Bates 11140*, wooded slopes N Albury, 19.x.1987 (AD); *R.Bates 11170*, Carabost, 20.x.1987 (AD); *H.Beattie MEL 31629*, near Albury, s.dat. (MEL); *N.T.Burbidge 488*, Walbundrie, 13.5 miles SE Burrumbulooh, 7.xii.1946 (CANB); *E.J.McBarron 1989*, Monument Hill, Albury, 12.ix.1948 (NSW); *E.J.McBarron 2997*, Nail Cann Hill, Albury, 22.i.1949 (NSW).

Victoria. **EHL:** *A.C.Beauglehole 43590*, 6 miles N Beechworth, 23.xi.1973 (CANB, MEL); *A.C.Beauglehole 88573 & H.M.Curtis*, Baranduda Range, Regional Park, 15.ix.1987 (MEL); *A.C.Beauglehole 91272 & C.C.Taylor*, Lockhart Creek Education Centre, 9.xi.1987 (MEL); *E.M.Canning 473*, 33.8 km Springhurst to Beechworth along Cemetery Road, 28.xii.1967 (CANB); *E.M.Canning 479*, along Forest Road towards Chiltern & Wooragee, 28.xii.1967 (CANB); *E.M.Canning 4473*, towards Carboor, opposite Carnavon homestead, 8.x.1978 (CANB); *N.Henley MEL 31610*, Ovens River, 1891 (MEL); *N.McKibbin MEL 31712*, Hume River, Wodonga, x.1887 (MEL); *A.Meebold 21642*, Tallangatta, xii.1936 (CANB); *F.Mueller MEL 31609*, hills between the Ovens and Broken rivers, 16.ii.1850 (MEL); *N.G.Walsh 5614*, Insolvent Track, 1.9 km N from Mt Ray Rd; upper south slopes of Mt Difficult, 25.x.2002 (AD); *J.H.Willis MEL 502148*, Crown Land W of Annuello, 18.ix1971 (CANB).

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Once a nucleus of this paper was established by HRT, more consignments of specimens from RTM and Jan Miller, as well as Colin Gibson, kept increasing the scope of this article to the extent that there are now additional taxa that need further information before they can be published and discussed. We would like to thank them, in particular for the many follow-ups, including mass collections and information of, for instance, variants of the *H. puberula* complex, to be able to make a more considered decision of the taxa here described. Similarly, the independent assessment and specimen of *H. puberula* subsp. *glabrescens* collected by Geoff Cunningham was appreciated in deciding the level of taxa proposed. Additional specimens, especially of the *H. rufa* group, received from Stephen Bell are also gratefully acknowledged.

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Name changes associated with the South Australian census of vascular plants for the calendar year 2011

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The following tables show the changes, and the reasons why they were made, in the census of South Australian vascular plants for the calendar year 2011. The census is maintained in a database by the State Herbarium of South Australia and projected on the web on the eFloraSA site (*www.flora.sa.gov.au*). Any changes made to the census database are reflected on the web page the next day.

The Census recognises two broad categories of plants, native and naturalised. Those species which have been introduced to South Australia and have then become naturalised are indicated by an asterisk before their name and are treated in Tables 2 and 4 below. Species lacking an asterisk are considered to be native to South Australia. There are a few species which do not fall happily into either category and two examples are listed for 2011 in Table 5.

Names change for several reasons. Sometimes they result from a change in the taxonomy or circumscription of the species concerned. Alternatively name changes can occur which do not affect the concept of the species, or at least not in the context of South Australia. Species listed in Tables 1 and 2 fall into the latter category and so these can be considered as replacement names for species which were already present in the census. A number of the changes recognised in 2011 were due to informal phrase names in *Eremophila*, *Spergularia*, *Caladenia* and *Thelymitra* being formalised, e.g. *Eremophila sp. Fallax (D.E.Symon 12311)* was the informal phrase name for the now formally published *Eremophila fallax* Chinnock. Other changes were due to the decision to treat *Chamaesyce* as a subgenus of *Euphorbia*, thus necessitating the change of all species previously listed as *Chamaesyce* to the appropriate name in *Euphorbia*, and likewise the decision to treat the segregate genera *Hebe* and *Parahebe* as *Veronica*. Others are just corrections associated with the misspelling of epithets.

Species listed in Tables 3-5 are either completely new to the state (i.e. species which have not been listed for South Australia in past censuses) or they are new species or new records which have been treated as part of another species in previous censuses.

It will be noted that sometimes the references supporting these changes are dated several years prior to 2011. It can take some time to decide whether suggested changes will be adopted since published opinion is not always accepted by the greater botanical community. Rather than making the requisite change and then finding that the name has to be changed back again, as has happened for some of the grass species, change is only made when there is some certainty that this will not happen.

Table 1. Native plants already recognised, but whose names have changed.

Actites megalocarpus (Hook.f.) Lander	Correction of spelling of epithet only.
Caladenia cruciformis D.L.Jones	Specimens previously referred to as *Caladenia sp. Bordertown (R.S.Rogers 788)* R.J.Bates are equated with this species. Also referred to as *Arachnorchis cruciformis* (D.L.Jones) D.L.Jones & M.A.Clem. in some literature.
Caladenia strigosa (D.L.Jones) R.J.Bates	New name and new combination provided for previous *C. australis* and *Arachnorchis strigosa*. See Barker & Bates (2008).
Cryptandra campanulata Schltdl.	Existing published name for *Cryptandra sp. Long hypanthium (C.R. Alcock 10626)* W.R.Barker (pers. comm. Jürgen Kellermann, AD).
Drosera whittakeri Planch.	With the raising of *D. whittakeri* subsp. *aberrans* to species (Lowrie & Conran 2008) there is no longer a subsp. *whittakeri* or subsp. *aberrans*.
Eremophila decussata Chinnock	Published name for *Eremophila sp. Decussate (R.J.Chinnock 7735)* Chinnock. See Chinnock (2007).

Eremophila dendritica Chinnock	Published name for *Eremophila sp. Dendritica (W.S.Reid AD 98581189)* Chinnock. See Chinnock (2007).
Eremophila fallax Chinnock	Published name for *Eremophila sp. Fallax (D.E.Symon 12311)* Chinnock. See Chinnock (2007).
Eremophila gilesii F.Muell. subsp. *gilesii*	*E. gilesii* split into two subspecies, only one of which occurs in South Australia. See Chinnock (2007).
*Eremophila glabr*a (R.Br.) Ostenf. subsp. *murrayana* Chinnock	Published name for *Eremophila glabra* (R.Br.) Ostenf. *subsp. Murray (A.G.Spooner 14470)* Chinnock. See Chinnock (2007).
Eremophila hygrophana Chinnock	Published name for *Eremophila sp. Hygrophana (P.J.Lang B894-2828)* Chinnock. See Chinnock (2007).
Eremophila obovata L.S.Sm. subsp. *obovata*	Variety *obovata* raised to subspecies in Chinnock (2007).
Eremophila paisleyi F.Muell. subsp. *glandulosa* Chinnock	Published name for *E. paisleyi* F.Muell. *subsp. Glandular (F.J.Badman 6011)* Chinnock. See Chinnock (2007).
Eremophila parvifolia J.M.Black subsp. *parvifolia*	Second subspecies recognised by Chinnock (2007) and so autonym established.
Eremophila platythamnos Diels subsp. *villosa* Chinnock	Published name for *Eremophila platythamnos* Diels *subsp. Villous (A.C.Robinson NPWS82)* Chinnock. See Chinnock (2007).
Eremophila subfloccosa Benth. subsp. *glandulosa* Chinnock	Published name for *Eremophila subfloccosa* Benth. *subsp. Glandulosa (R.Bates 32961)* Chinnock. See Chinnock (2007).
Eremophila subfloccosa Benth. subsp. *lanata* Chinnock	Published name for *Eremophila subfloccosa* Benth. *subsp. Lanata (R.Bates 33587)* Chinnock. See Chinnock (2007).
Eremophila willsii F.Muell. subsp. *integrifolia* (Ewart) Chinnock	Variety *intregrifolia* raised to subspecies. See Chinnock (2007).
Eremophila willsii F.Muell. subsp. *willsii*	Variety raised to subspecies. See Chinnock (2007).
Euphorbia alsiniflora Baill.	Replacement name for *Chamaesyce coghlanii* (F.M.Bailey) D.C.Hassall ex P.I.Forst. & R.J.F.Hend. Following molecular work, the Australian Plant Census decision was to adopt the name Euphorbia with Chamaesyce as a subgenus. See PBI Euphorbia Project (ongoing).
Euphorbia australis Boiss.	Replacement name for *Chamaesyce australis* (Boiss.) D.C.Hassall.
Euphorbia centralis B.G.Thomson	Replacement name for *Chamaesyce centralis* (B.G.Thomson) P.I.Forster & R.J.F. Henderson.
Euphorbia dallachyana Boiss.	Replacement name for *Chamaesyce dallachyana* (Boiss.) D.C.Hassall.
Euphorbia drummondii Boiss.	Replacement name for *Chamaesyce drummondii* (Boiss.) D.C.Hassall.
Euphorbia flindersica Halford & W.K.Harris	Replacement published name for *Chamaesyce sp. Papillose plants (D.E.Symon 14628)* R.M.Barker of Barker et al. (2005). See Halford & Harris (2010).
Euphorbia inappendiculata Domin var. *queenslandica* Domin	Replacement name for *Chamaesyce sp. Marree (F.J.Badman 776)* W.R.Barker. See Halford & Harris (2010) for comment on the identity of this taxon.
Euphorbia mitchelliana Boiss.	Replacement name for *Chamaesyce mitchelliana* (Boiss.) D.C.Hassall.
Euphorbia schultzii Benth.	Replacement name for *Chamaesyce schultzii* (Benth.)D.C.Hassall.
Euphorbia wheeleri Baill.	Replacement name for C*hamaesyce wheeleri* (Baill.)D.C.Hassall.
Flaveria trinervia (Spreng.) C.Mohr	Previously treated as *F. australasica* Hook. Bean (2009) stated that *F. australasica* is the same as *F. trinervia* and it is introduced, but at this stage we have continued to indicate it as native — to be reviewed.
Glinus oppositifolius (L.) Aug.DC.	Previously treated as *G. oppositifolia* (L.) A.DC. Incorrect ending for species name and incorrect authorship.
Leptosema chambersii F.Muell.	Previously treated as *L. chambersii* F.Muell. subsp. *chambersii*. Between 1986 and 1993 subspecies rank was used in the census for no apparent reason and this is now corrected.
Myriocephalus rhizocephalus (DC.)Benth.	Previously as *M. rhizocephalus* var. *rhizocephalus*. However *M. rhizocephalus* var. *pluriflorus* has been raised to species level and so there is now no need for the autonym.
Olearia pimeleoides (DC.)Benth.	Lander (2008) raised subsp. *incana* to species level and so subsp. *pimeleoides* is no longer recognised.
Ptilotus gaudichaudii (Steud.) J.M.Black subsp. *gaudichaudii*	Name arising from split of *P. gaudichaudii* into 3 subspecies rather than 2 varieties. See Lally & Barker (2010).
Ptilotus gaudichaudii (Steud.) J.M.Black subsp. *parviflorus* (Benth.) Lally	Name arising from split of *P. gaudichaudii* into 3 subspecies rather than 2 varieties. See Lally & Barker (2010).

Ptilotus helipteroides (F.Muell.) F.Muell.	Previously as *P. helipteroides* var. *helipteroides*, but since var. *minor* is now treated as *P. pseudohelipteroides* (Bean 2008), varietal status is superfluous.
Ptilotus latifolius R.Br.	Previously recognised varieties of this species are no longer recognised (Bean 2008).
Ptilotus nobilis (Lindl.) F.Muell. subsp. *angustifolius* (Benl) Lally & W.R.Barker	Previously as var. *angustifolius*, now raised to subspecies level. See Lally & Barker (2010).
Ptilotus nobilis (Lindl.) F.Muell. subsp. *semilanatus* (Lindl.) A.R.Bean	*P. exaltatus* var. *semilanatus* raised to subspecies under *P. nobilis*. See Lally & Barker (2010)
Ptilotus polystachyus (Gaudich.) F.Muell.	Varieties listed previously are no longer recognised. See Davis & Butcher (2010).
Ptilotus pseudohelipteroides Benl.	Recognition of *P. helipteroides* var. *minor* at species rank by Bean (2008).
Ptilotus schwartzii (F.Muell.) Tate	Previously *P. schwartzii* F.Muell. ex Tate f. *schwartzii* Forms of this species are not recognised following Palmer & Lally (2011); "until this work [on infraspecific taxa, especially in WA] progresses, taxa in S.A. are best referred to as Ptilotus schwartzii, in line with [...] Bean (2008)."
Ptilotus sessilifolius (Lindl.) Benl	Renamed without subspecies following Bean (2008). See Palmer & Lally (2011).
Schoenoplectus subulatus (Vahl) Lye	Australian material previously as *S. litoralis* (culms triangular in cross-section and found from the Mediterranean region east to China) belongs with *S. subulatus* (culms terete but trigonous below inflorescence). Even if the species are combined, as done by some authors, the earlier name is *S. subulatus*; pers. comm. Karen Wilson (NSW) 22 Sep. 2011.
Spergularia bocconei (Scheele) Graebn.	Corrected spelling of epithet. See Adams et al. (2008).
Spergularia brevifolia (Bartl.)Walp.	Published name for *Spergularia sp. Mt Mulyah (C.W.E.Moore 7046)* L.G.Adams used in Barker et al. (2005). Previously part of *S. marina*, *S. diandra* and *S. rubra*. See Adams et al. (2008).
Spergularia diandroides L.G.Adams	Published name for *Spergularia sp. Densely papillose (E.N.S.Jackson 2133)* used in Barker et al. (2005). Previously part of *S. diandra*. See Adams et al. (2008).
Spergularia tasmanica (Kindb.)L.G.Adams	Published name for *Spergularia sp. Butchers Gap (P.Gibbons 234)* used in Barker et al. (2005). Previously part of *S. media*. See Adams et al. (2008).
Thelymitra crenulata R.J.Bates	Published name for *Thelymitra sp. Black buds (R.J.Bates 64389)* R.J.Bates. See Bates (2010). Part of T. pauciflora complex.
Thelymitra pallidifructus R.J.Bates	Part of *T. pauciflora* complex but the circumscription of *T. pauciflora* is no longer clear and so treated as a new species. Referred to as *Thelymitra sp. Pale capsules (R.Bates 64170)* R.J.Bates in the unpublished account of the Orchids of S Australia on CD (Bates 2007). See Bates (2010).
Veronica decorosa F.Muell.	Segregate genera (*Hebe*, *Parahebe*, etc) returned to *Veronica*. See Garnock-Jones et al. (2007).

Table 2. Naturalised species whose names have changed.

**Cotoneaster symondsii* T.Moore	Previously listed as *Cotoneaster simonsii* Baker. The spelling of the epithet varies considerably for this species and it was unclear which was correct. Discussion with interstate colleagues involved in the Australian Plant Census and overseas bodies determined that the spelling and authorship needed to be changed to *C. symondsii* T. Moore.
**Cyclospermum leptophyllum* (Pers.) Sprague ex Britton & P. Wilson	Originally spelled as *Ciclospermum*. *Cyclospermum* was the conserved spelling adopted by the botanical community in 1993 (Nicolson 1993).
**Euphorbia hyssopifolia* L.	Originally as *Chamaesyce hyssopifolia* (L.) Small. Following molecular work, the Australian Plant Census decision was to adopt the name Euphorbia with Chamaesyce as a subgenus. See PBI Euphorbia Project (ongoing).
**Euphorbia maculata* (L.) Small	Originally as *Chamaesyce maculata* (L.) Small.
**Lotus corniculatus* L. var. *tenuifolius* L.	Originally as *Lotus corniculatus* L. var. *tenuifolia* L. Spelling of varietal epithet corrected.
**Monoculus monstrosus* (Burm.f.) B.Nord.	Originally as *Tripteris clandestina* Less. A new name for this taxon published by Nordenstam (2006).
**Torilis arvensis* (Huds.) Link	Originally as *Torilis arvensis* (Huds.) Link subsp. *purpurea* (Ten.) Hayek. There is some confusion about the correct name to apply to this species and it also seems likely that there is more than one taxon in South Australia. Further specimens are required to sort this out.
**Veronica speciosa* R.Cunn. ex A.Cunn.	Previously as *Hebe speciosa*. The segregate genera (*Hebe*, *Parahebe*, etc.), have been returned to *Veronica*. See Garnock-Jones et al. (2007).
**Veronica parviflora* Vahl	Previously as *Hebe parvifolia*. See above.

Table 3. Native species which are new to South Australia or which have had their circumscription changed

Caladenia aurulenta (D.L.Jones) R.J.Bates	New species for South Australia originally described as *Arachnorchis*. Combination in *Caladenia* provided by Barker & Bates (2008).
Caladenia fuliginosa (D.L.Jones) R.J.Bates	New species for South Australia originally described as *Arachnorchis*. Combination in *Caladenia* provided by Barker & Bates (2008).
Caladenia interanea (D.L.Jones) R.J.Bates	New species for South Australia originally described as *Arachnorchis*. Combination in *Caladenia* provided by Barker & Bates (2008).
Caladenia leptochila Fitzg. subsp. *dentata* (D.L.Jones) R.J.Bates	New subspecies for South Australia originally described as *Arachnorchis*. Combination in *Caladenia* provided by Barker & Bates (2008).
Caladenia leptochila Fitzg. subsp. *leptochila*	With the recognition of a new subsp. the circumscription of this taxon has changed. The regional distribution, particularly FR, of the re-circumscribed subsp. *leptochila* needs assessment.
Cassinia wilsoniae Orchard	New species for South Australia from MU region. See Orchard (2009).
Chrysocephalum vitellinum Sond. & F.Muell. ex Sonder	*C. vitellinum* was split from *C. apiculatum* by Paul Wilson (2008) but the distinguishing characters were not given. See *Flora of Victoria* for differences between *C. apiculatum* and *C. vitellinum* (as *Chrysocephalum* sp. 2). Distribution of both taxa in South Australia needs to be confirmed and is presently confined to those specimens cited in the article.
Dodonaea petiolaris F.Muell.	New species for South Australia from LE region (based on collection *D.C. Bickerton 112 & P.J.Lang* from Cordillo Downs).
Drosera gracilis Planch.	Part of the *Drosera peltata* complex. This has been split into 3 species. See Conran & Marchant (2011) or Gibson et al. (2010). Recorded for SL and SE regions.
Drosera hookeri R.P.Gibson, B.J.Conn & Conran	Part of the *Drosera peltata* complex. This has been split into 3 species. See. Conran & Marchant. (2011) or Gibson et al. (2010). Recorded for FR, EP, NL, MU, YP, SL, KI and SE regions.
Drosera peltata Thunb.	Re-circumscription of this species due to the splitting of this complex into three species. See Conran & Marchant (2011) or Gibson et al. (2010). Recorded for FR, EP, NL, MU, YP, SL, KI and SE regions.
Epacris obtusifolia Sm.	Neville Walsh (of the National Herbarium of Victoria) confirms a Wehl collection in MEL from near Mt Gambier in 1880. This is presumably the basis for Tate (1890) and Black (1926) recording *E. obtusifolia* for the SE region. There is no other specimen supporting its occurrence in the SE region or in South Australia.
Eremophila forrestii F.Muell. subsp. *forrestii*	*E. forrestii* F.Muell. was split into 4 subspecies by Chinnock (2007). Two of the subspecies occur in the NW region of South Australia. All collections by Pastoral Board from Mt Moulden.
Eremophila forrestii F.Muell. subsp. *viridis* Chinnock	See previous subspecies.
Lachnagrostis aemula (R.Br.) Trin.	Re-circumscribed by the removal from it of the new species, *L. palustris*. See Brown (2008).
Lachnagrostis batesii A.J.Br.	A new species for the SL region of South Australia. Split from *L. filiformis*. See Brown (2008).
Lachnagrostis filiformis (G.Forst.)Trin.	Re-circumscribed by the removal of the new species, *L. batesii*. See Brown (2008).
Lachnagrostis palustris A.J.Br.	A new species for the SE region of South Australia. Split from *L. filiformis* and *L. aemula*. See Brown (2008).
Lachnagrostis perennis (Vickery) A.J.Br.	Split from *L. filiformis* (G.Forst.) Trin. and using the existing varietal name (*Agrostis avenacea* var. *perennis* Vickery) at species level. See Brown (2008).
Mentha atrolilacina B.J.Conn & D.J. Duval	Some SE specimens of *Mentha diemenica*, previously treated as aff. *diemenica* have been described as a new species only known from the SE region (Honans Native Forest Reserve). See Conn & Duval (2010)
Mentha diemenica Spreng.	Re-circumscription of *M. diemenica* by splitting it into two species. See *M. atrolilacina* above.
Newcastelia cephalantha F.Muell. var. *oblonga* Munir	Added as a new record for South Australia from the LE region. Note however that Rye (1996) in a review in Nuytsia did not recognise the varieties of N. *cephalantha*.
Potamogeton reduncus Hagstr.	Added as new species for South Australia based on the treatment by Papassotiriou et al. (2011) and the citation there of an AD specimen from EP. There may be more material amongst the rest of *Potamogeton* specimens in AD. Note also

	that the Australian Plant Census and the WA Census treat this species as a synonym of P. *drummondii* and so the name may change again.
Ptilotus aristatus Benl subsp. *aristatus*	The two varieties of *P. aristatus*, var. *aristatus* and var. *eichlerianus*, have been combined as subsp. *aristatus*. See Albrecht & Lally (2010).
Ptilotus clementii (Farmar) Benl	Added as a new record for South Australia from the NW region following Palmer & Lally (2011).
Ptilotus fusiformis (R.Br.) Poir.	Added as a new record for South Australia from the LE region following Palmer & Lally (2011). Known only by a single collection well south of its normal distribution.
Ptilotus incanus (R.Br.) Poir. ex F.Muell.	*P. obovatus* var. *griseus* and *P. incanus* var. *parviflorus* are now treated as synonyms of *P. incanus* and so no varieties are now recognised. See Palmer & Lally (2011).
Ptilotus murrayi F.Muell.	The previous varieties of *P. murrayi* are no longer recognised. See Palmer & Lally (2011).
Ptilotus nobilis (Lindl.) F.Muell. subsp. *nobilis*	Variation in *P. nobilis* is now treated at the subspecies rather than the varietal level. This taxon also includes *P. exaltatus* which has been reduced to synonymy. See Lally & Barker (2010).
Ptilotus obovatus (Gaudich.) F.Muell.	Specimens previously identified as *P. astrolasius* for South Australia have been re-determined as *P. obovatus*, and thus *P. astrolasius* has been removed from the Census. See Palmer & Lally (2011). Var. obovatus is no longer recognised since var. griseus has been treated as a synonym of *P. incanus* (q.v.).
Ptilotus spathulatus (R.Br.) Poir.	The two forma of P. *spathulatus* are no longer recognised. See Lally & Barker (2010).
Sclerolaena minuta (Ising) A.J.Scott	Added as a new record for South Australia from Cordillo Downs in the LE region in May 2011.
Thelymitra holmesii Nicholls	The splitting of *T. hygrophila* from *T. holmsei* means a re-circumscription of *T. holmesii*, part of the *T. pauciflo*ra complex (Bates 2010). The original *T. holmesii* was split into *T. holmesii* and *T. peniculata*.
Thelymitra hygrophila R.J.Bates	A new species, part of the *T. pauciflora* complex, published by Bates (2010). Split from *T. holmesii* and previously referred to as *Thelymitra sp. Springton* with both *Bates 63666* and *Bates 64102* cited as voucher specimens.
Thelymitra latifolia R.J.Bates	Replacement name for *Thelymitra sp. Latifolia (R.Bates 64108)* or *Thelymitra sp. Latifolia (R.Bates 64051)*. Original specimens of *T. peniculata* Jeanes, part of the *T. pauciflora* complex, were split into two species with much of the material previously identified by Jeanes as *T. peniculata* for South Australia transferring to *T. latifolia* — the distribution of this taxon is given by Bates as FR, NL, MU, SL and SE but still needs to be backed up by herbarium specimens. See Bates (2010).
Thelymitra mucida Fitzg.	*T. orientalis* has been split from *T. mucida*, part of the *T. pauciflora* complex, which is now considered to be predominantly Western Australian. It is not clear whether *T. mucida* still occurs in South Australia. See Bates (2010).
Thelymitra odora R.J.Bates	A new species, part of the *T. pauciflora* complex, published by Bates (2010). Previously referred to as *Thelymitra sp. Slate Buds (R.Bates 64092)* or *Thelymitra sp. Odorata (R.Bates 61708)*. MU is listed as a region of occurrence for this species but no specimens have been cited.
Thelymitra orientalis R.J.Bates	*T. orientalis*, part of the *T. pauciflora* complex, has been split from *T. mucida* which is now considered to be predominantly Western Australian. It is not clear whether *T. mucida* still occurs in South Australia or not. See Bates (2010).
Thelymitra peniculata Jeanes	Re-circumscription of *Thelymitra peniculata* Jeanes, part of the *T. pauciflora* complex.The original specimens of *T. peniculata* Jeanes of South Australia were split into *T. latifolia* and *T. peniculata* (See Bates 2010). The distribution of *T. peniculata* in South Australia is given as SL, KI and SE but this distribution needs to be verified with specimens.
Thelymitra rubricaulis R.J.Bates	A new species, part of the *T. pauciflora* complex, published by Bates (2010). Previously referred to as *Thelymitra sp. Rubricaulis (R.Bates 64273)*.
Viola betonicifolia Sm. subsp. *novaguineensis* D.Moore	Recognition of an additional subspecies for the SE region. It is characterised by hastate leaf bases.

Table 4. New naturalisations in South Australia.

**Aloe brevifolia* Haw.	New record for South Australia from EP region.
Artemisia pontica* L. (Roman wormwood**).	New record for South Australia from SL region. Spontaneous in garden at Mt Barker, recorded as questionably naturalised.
Centaurea moncktonii* C.E.Britton (Meadow knapweed**)	New record for South Australia from SL region. A specimen previously determined as *C. nigra* was re-identifed as *C. moncktonii* by Tony Bean (BRI). *Centaurea moncktonii* is a hybrid between *C. jacea* L. and *C. nigra* L.
**Crassula sarmentosa* Harv. var. *sarmentosa*	New record for South Australia for SL (*O'Leary 3697*), KI (*Bates 61092*) and SE (*Brodie 2788*) regions
Echium candicans* L.f. (Pride of Madeira**)	New record for South Australia from SL and SE regions. Most of these records were initially identified as *E. simplex* in 2008 but this had not been projected in any publications.
**Escallonia macrantha* Hook. & Arn.	New record for South Australia from SL and SE regions of this ornamental. Its occurrence has been known for some time. Presently specimens are identified as both *E. rubra* and *E. macrantha* but the taxonomy surrounding this species is in need of clarification.
**Felicia echinata* (Thunb.) Nees	New record for South Australia, from SL and EP regions, of a commonly grown garden shrub. Naturalised status in both regions is questionable.
Freesia laxa* (Thunb.) Goldblatt & J.C.Manning (False freesia**)	New record for South Australia from SL and YP regions of South Australia.
Genista ×spachiana Webb (**Sweet broom**)	New record for South Australia from SE region of South Australia
Helianthus tuberosus* L. (Jerusalem artichoke**)	New record for South Australia from SL region.
Heteropogon contortus* (L.) P.Beauv. ex Roem. & Schult. (Black speargrass**)	New record for South Australia from GT region. Thirty tussocks were noted in a Stuart Hwy roadside area.
Hypericum androsaemum* L. (Tutsan**)	New record for South Australia from SL region. Weedy plant of concern because of the red berries it produces; these are likely to be bird dispersed. Already naturalised in other states.
Nassella tenuissima* (Trin.) Barkworth (Mexican feather grass**)	Only known in garden situations which continue to be monitored, but new plants are continuing to appear each year in SE (pers comm. Chris Brodie), KI (*R.Wiadrowski s.n., AD 234869*) and SE (*A.Kurray s.n., AD 234870*).
Ornithopus sativus* L. (French Serradella**)	The collection *Bates 60051*, collected from Hilltown in the Northern Lofty region in 2001, was initially identified as *O. sativus*. In 2008 it was re-identified as *O. compressus*. Since it was the only record in the herbarium of *O. sativus* the name was removed from the census. In 2011 the collection was again referred to *O. sativus* and so the name was added to the census again. Whether it is truly naturalised has yet to be established and further collections would be appreciated.
Vicia villosa* Roth subsp. *eriocarpa* (Hausskn.) P.W.Ball (Hairy vetch**)	New record for South Australia from SE region. Specimens had been identified as this by A. Holland (BRI) as early as 1993, when she was preparing the account of *Vicia* for the Flora of Australia. This account has yet to be published and so the specimen and name had been overlooked.

Table 5. Native or not?

Streptoglossa decurrens (DC.) Dunlop	New record for South Australia from LE region. It is questionable whether this should be regarded as part of the natural range of the species or an expansion of range because of floods or people movement.
*Helichrysum luteoalbu*m (L.) Rchb.	Previously treated as *Pseudognaphalium luteoalbum* (L.) Hilliard & B.L.Burtt. See Galbany-Casals et al. (2004). Continues to be treated as questionably native.

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JOURNAL of the ADELAIDE BOTANIC GARDENS

Volume 25 — 10 July 2012

Volume 25

Contents

JOURNAL of the ADELAIDE BOTANIC GARDENS

10 July 2012